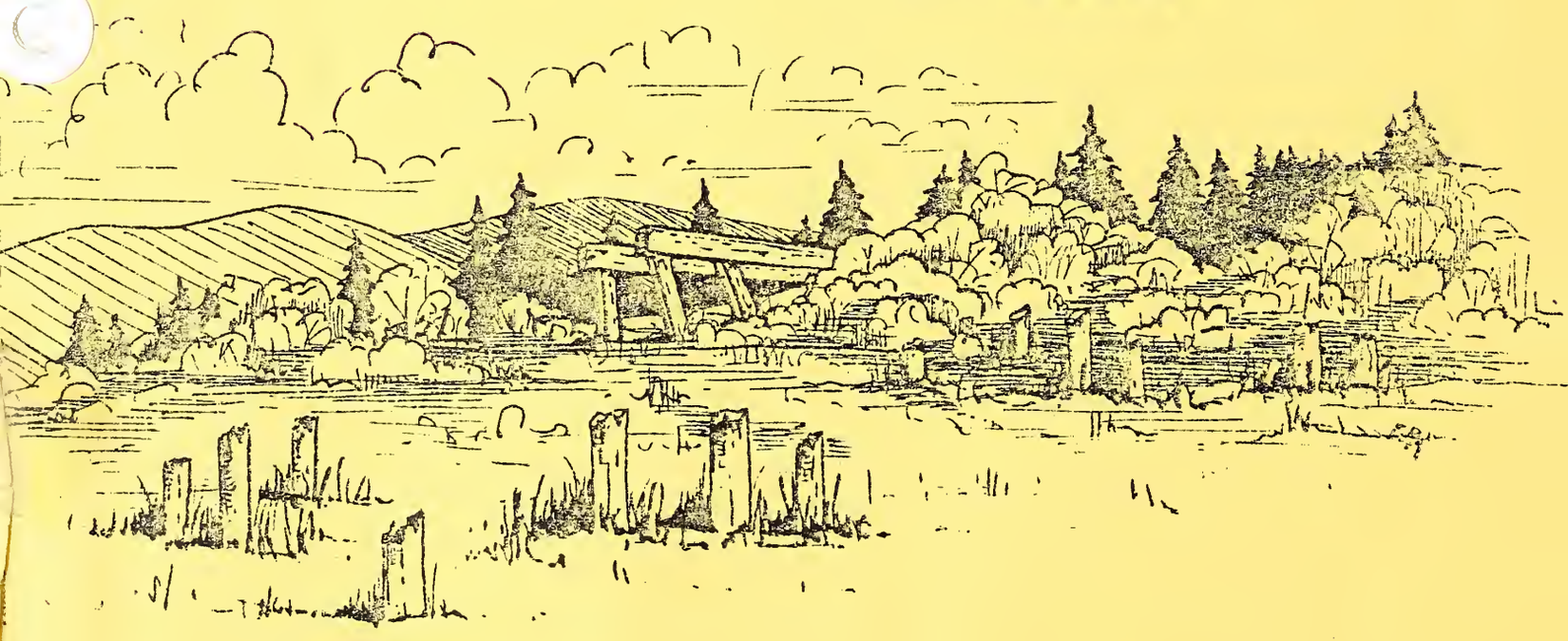
# DRAFT
# ENVIRONMENTAL IMPACT STATEMENT



## PROPOSED PLAN OF MINING AND RECLAMATION
## ZORTMAN MINING COMPANY
## AND
## LANDUSKY MINING COMPANY
## PHILLIPS COUNTY, MONTANA





MONTANA DEPARTMENT OF STATE LANDS

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AND

LANDUSKY MINING COMPANY

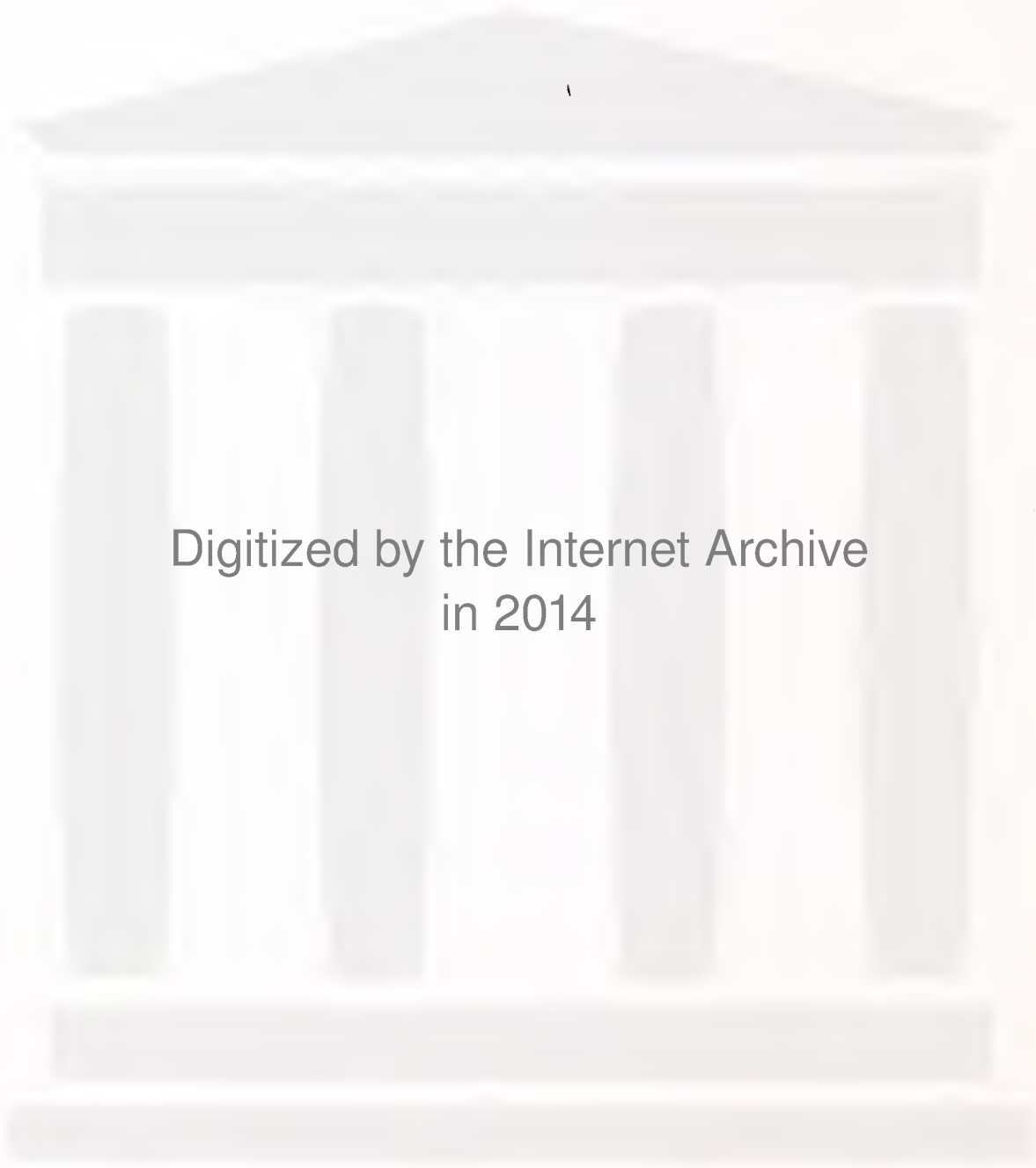
PHILLIPS COUNTY, MONTANA

Prepared by

Montana Department of State Lands

Commissioner
Montana Department of State Lands

Environmental Administrator
Montana Department of State Lands



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# INTRODUCTION

## Preface

This statement was prepared by the Montana Department of State Lands and represents an analysis of broad cumulative environmental impacts of two proposed gold and silver mines by Zortman Mining Company and Landusky Mining Company in the Little Rocky Mountains, Phillips County, Montana.

In June, 1978, Zortman Mining Company and Landusky Mining Company communicated to the Montana Department of State Lands (Department) plans for submission of permit applications for development of the Little Rocky Mountains gold-silver deposits near the towns of Zortman and Landusky, Phillips County, Montana. The companies subsequently submitted to the Department, for review, a baseline environmental study of the areas compiled by WESTECH Inc. at the request of the companies during 1977 and early 1978.

The companies filed hard rock operating permit applications with the Department June 19, 1978. Plans of operation for the projects were received by the Department on the same date.

The Montana Environmental Policy Act (MEPA) requires that Environmental Impact Statments (EIS) be prepared on proposals for projects, programs, legislation, and other major actions of state government significantly affecting the quality of the human environment (Section 69-6504, R.C.M. 1947). Pursuant to MEPA, the Department, after permit application review, determined that a draft EIS must be prepared on the proposed actions. The Department has adopted rules pursuant to MEPA (MAC 26-2.2(18)-P250).

## Agency Responsibilities and Interagency Relationships

### Responsibilities of Montana State Agencies

### Department of State Lands

The Montana Board of Land Commissioners[1/] (Board) and Montana Department of State Lands[2/] (Department) are responsible for the administration of the MONTANA HARD ROCK LAW (Title 50, Chapter 12, R.C.M. 1947). Pursuant to its duties as administering agency for the HARD ROCK LAW, the Department must review and then grant or deny a Hard Rock-mine permit or permit amendment within a period negotiable with the applicant to be not less than 60 days, nor more than 425 days after the submission of a complete permit application. The Department reviews applications for conformance with provisions of the Hard Rock Law regarding the method of operation, water control, air quality, mine waste disposal, topsoiling and for the reclamation of lands affected by the proposed mining operations. The Board may adopt rules to accomplish the purpose of the Hard Rock Law, and the Department may adopt rules with respect to the filing of reports and the issuance of permits. To insure compliance with the Hard Rock Law and rules adopted pursuant to the Law, the Department is required to make mine inspections and investigations as necessary.

The Department may not approve Hard Rock-mining in areas which meet the criteria for selective denial provisions as specified in Section 50-1214 of the Hard Rock Law. The Department may conduct studies or encourage others to conduct studies of hard rock-mining and hard rock-mining land reclamation.

When the operator is not in compliance with requirements of the Hard Rock Law, rules pursuant to the Law, or orders of the Department and has not achieved compliance within time limits set by the Department, the commissioner shall serve a notice of noncompliance on the operator or if necessary, he shall order the suspension of the permit. After a hearing, the Board shall order the Department to revoke the permit if requirements specified in the notice of noncompliance, in the order of suspension, or if an order of the Board requiring remedial measures have not been satisfied.

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[1/] The Board of Land Commissioners consists of the Governor, Attorney General, Superintendent of Public Instruction, State Auditor and Secretary of State.

[2/] The Commissioner of State Lands is the chief administrative officer for the Department of State Lands and is appointed by and serves at the pleasure of the Governor.

## Montana Department of Health and Environmental Services

The Air Quality Bureau of the Department of Health and Environmental Sciences has primary responsibility for air pollution control activities in the state of Montana. These responsibilities include the review of new sources of air pollution to be located in the state, enforcing standards and ensuring that Federal standards are achieved and maintained.

The Montana Clean Air Act (Title 69, Chapter 39, R.C.M. 1947) provides rule making authority to the Board of Health in regard to permits (Section 69-3911). This rule making authority was exercised by the adoption of rule MAC 16-2.14(1)-S1400, Permits, Construction and Operation of Equipment. This rule provides that, prior to the construction or operation of any new or modified equipment of certain categories, a permit be obtained from the Department of Health, Air Quality Bureau. In the instant case, Zortman Mining Company and Landusky Mining Company zinc filter press buildings and other support buildings are the subject facilities and will be required to obtain a construction permit. This EIS will serve in large part as the review basis for both companies construction permit requests.

In addition to the permits required, various facilities of development will be subject to certain emission standards as contained in the Administrative Records of Montana. The primary regulated sources would be the crushers and concentrator, and the emissions of most concern that of particulate matter.

The Air Quality Bureau is also charged with achieving and maintaining both the state and federal ambient air quality standards. The Montana State Implementation Plan describes the state's efforts in achieving and maintaining federal ambient air quality standards. One requirement of this plan is that it provide for the achievement and maintenance of federal primary ambient air quality standards as soon thereafter as is practicable. In many areas of the state, and of the nation, the strategies to achieve the standard have not accomplished their desired result, i.e., achievement of the standard, but such achievement remains a primary goal of the agency.

On January 18, 1974, the Board of Health and Environmental Sciences adopted a rule, MAC 16-2.14(10-S14460), entitled the Montana Pollutant Discharge Elimination System (MPDES). This rule provided program elements needed by the State to administer a waste discharge permit program in the State of Montana. Section 4 of MAC 16-2.14(10)-S14460 states in part:

> *(c) The owner or operator of any proposed point source, which may discharge pollutants into state waters, shall file a completed MPDES permit application no less than 180 days prior to the day on which it is desired to commence operation of the point source . . .*

Section 69-4806 of RCM 1947 states in part: *It is unlawful to:*

> *(2) carry on any of the following activities without a current permit from the Department:*
>
> *(a) construct, modify, or operate a disposal system which*

*discharges to any state waters;*

*(b) construct or use any outlet for discharge of sewage, industrial waste, or other waste to state waters; or*

*(c) discharge sewage, industrial waste, or other waste into any state waters;*

Since the capacities of the leaching solution ponds and emergency storage ponds are designed to hold a 10 year 24 hour precipitation event, MPDES permits will be applied for in the event that this level is exceeded and resulting discharge occurs.

As specified in MAC 16-2.14(10)-S14460, application for an MPDES permit, for new or expanded point sources, must be made at least 180 days prior to that date upon which it is desired to commence discharging from the point source. The Department of Health and Environmental Sciences is required to public notice its intent to issue or deny an MPDES permit for a period of at least 30 days. If the Department feels that there is sufficient public interest in the proposed action, the Department will schedule a public hearing on the matter and public notice its intent to hold the hearing. Such public notice shall occur at least 30 days prior to the date of the hearing. Upon consideration of all comments and testimony received during the public notice period(s) and public hearing, the Department will make its final decision to issue or deny the MPDES permit.

MPDES permits may be issued for a term not to exceed five years. If the permittee wishes to continue to discharge beyond the expiration date of the permit, he must apply to the Department for renewal of the permit. Such application must be made at least 180 days prior to the expiration date of the permit. The Department must follow the same public notification and other procedures for renewals as for original applications.

The Department has several enforcement options available to it for compliance with the conditions of MPDES permits. Sections 69-4820, 69-3820.1, 69-4823, 69-4824, 69-4824.1 and 69-4825 of RCM 1947 present the various enforcement options available to the Department.

## Relationships Among State Agencies

Two State Agencies, the Department of State Lands, and the Department of Health and Environmental Sciences, have decisions to make in regard to the Zortman Inc. and Landusky Inc. proposal that require environmental review under the Montana Environmental Policy Act.

# I. DESCRIPTION OF ZORTMAN AND LANDUSKY MINING PROPOSALS

## A. Proposal of Zortman Mining Incorporated and Landusky Mining Incorporated

### 1. Background

#### a. Purpose

Zortman Mining Inc. proposes to develop and mine approximately 24.3 million tons of gold and silver ore. The project area is within the Little Rocky Mountains of Phillips County, the site of numerous past mining and leaching operations. Approximately six months would be required to develop the project, and mining is anticipated to proceed for 18-20 years. Pit run ore from the mine would be trucked approximately three quarters of a mile to the leach site where cyanide solution would be applied in a closed-circuit leaching process. Ore would be placed on an impervious barrier, the cyanide solution would be applied using pvc pipe and irrigation type sprinkler heads. A "pregnant" solution containing gold and silver values, would be recovered from the leach heap and pumped to a precipitation press to remove the gold and silver from solution. The barren solution would be adjusted for cyanide levels and re-applied to the leach heap. The leached heap materials would be graded and reclaimed in place. Concentrate from the press would either be sold unrefined or shipped to a custom smelter.

Landusky Mining Inc. proposes to develop and mine approximately 18.906 million tons of gold and silver ore over an 18-20 year mining period. This mine is located 3 miles west of the Zortman mine site. The ore will be trucked approximately a mile and a quarter from the pit to the leach area. Pit run ore will be leached by a cyanide soultion in a similar manner as that described for the Zortman Mining Inc. proposal.

#### b. Location and History

Both the Zortman Mining Company and Landusky Mining Company proposed operations are located in Phillips County, Montana, in the Little Rocky Mountains (Fig. I-1).

The Zortman project area is located in sections 7 and 18, T25N, R25E, Montana Principal Meridian (M.P.M.), and comprises approximately 274 acres. The project is located on patented claims leased by Gulf Resources Ltd. of Vancouver, British Columbia, and unpatented claims leased by the company, adjoined by Bureau of Land Management lands.

Acreage which would be affected in the Landusky area is located in Sections 15 and 22, T25N, R24E, Montana Principal Meridian (M.P.M.), and is approximately 256 acres. The project is located on patented claims leased from Wharf Resources Ltd. of Vancouver, British Columbia, and unpatented surface leased by the company, adjoined by Bureau of Land Management lands.

On June 29, 1977 both companies were issued Small Miner Exlusion Statements (SMES) which permits them to mine up to 36,500 tons of ore annually while keeping surface disturbance under 5 acres. The companies will operate under these SMES until there is a decision on the issuance of Operating Permits for the proposed full operations.

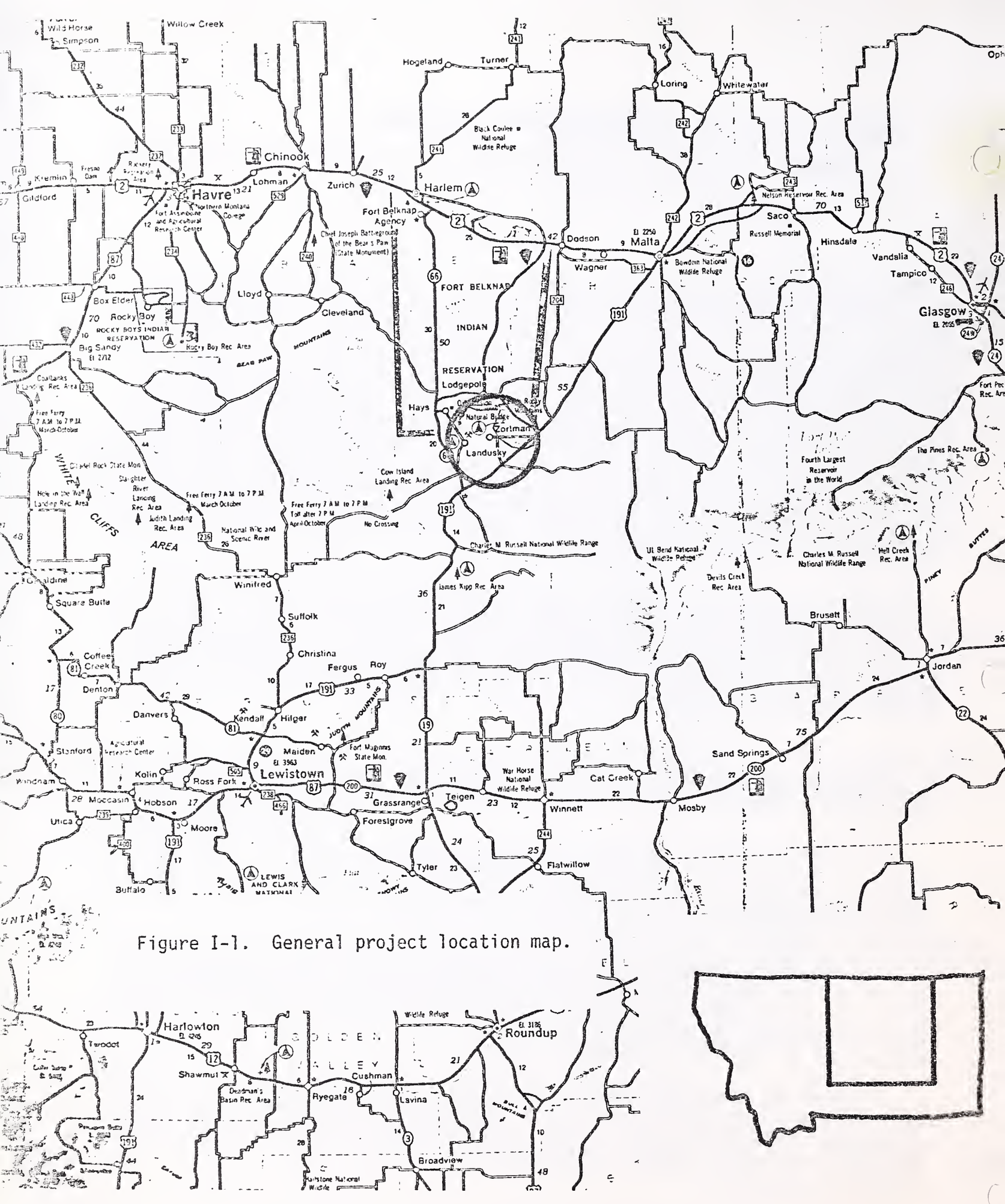



Figure I-1. General project location map.

c. Description of the Ore Body

The core of the Little Rocky Mountains consists of a circular, epizonal, igneous intrusive complex approximately 8 miles in diameter. These Tertiary intrusives are composed mainly of syenite prophyry and are believed to be laccolithic in form. Surrounding Paleozoic and Mesozoic sediments have been deformed into a broad domal structure by the emplacement of the igneous rocks.

Subsequent regional deformation resulted in faulting along the edges of the intrusive bodies and tensional fracturing within them. These fracture systems form the loci of the gold-silver mineralization. Two sets of fractures are commonly developed; a N50$^{o}$E set in the Landusky area, and a north-south set in the Zortman area. Oxidation (on both properties) generally persists to the levels of the deepest workings on the property which are 500 feet below surface.

Ore reserves at Landusky are estimated at 18.906 million tons of gold and silver ore. At Zortman, reserves are estimated bo be 24.3 million tons of gold and silver ore.

2. Mine Development

Currently at Landusky site there is an existing pilot heap-leach facility in operation. This operation is being conducted under a Small Miner Exlusion Statement.

At the Landusky facility site, development would consist of enlarging the pilot plant facilities to the requirements of increased ore tonnage and volume, including the leaching ponds and pad, and the construction of a larger metal building (60'x80') which will be used for the precipitation process, lunch room and sanitary facilities.

At Zortman, development would consist of the construction of the leach pad, leach ponds, and a 60'x80' facilities building similar to that of the Landusky operation.

The time frame for completion of the development is from 90-180 days. This would be dependent upon delivery time of necessary mining equipment to be ordered.

Each site would have a leach pad, and two leaching solution ponds. The Landusky site has an emergency storage pond for storing any overflow from the solution ponds.

Construction of the leach pad at each site would begin with the leveling of the pad areas with bulldozers. The pads would be graded (to a light slope) to provide for leach solution runoff towards the front of the heap. The pad would then be lined with 8"-12" of an impermeable clay (Bentonite) with a berm approximately 12" high at the front of the pad. A 36 mil liner would be placed over the berm to prevent erosion of the berm. Final dimensions of the pads would be approximately 840'x840'. Pads would be constructed so as to contain and direct all leaching solution and other precipitation runoff to the collecting point at the berm. The berm directs the solution to the pregnant pond.

Construction of the solution ponds at each site (barren and pregnant ponds) would begin by leveling and excavating two areas; the pregnant pond is down-gradient from the leach pad and the barren pond is down-gradient from the pregnant pond. The capacity of these ponds would be somewhat less than 500,000 gallons.

The ponds would be lined with bentonite, gravel and hypalon (Figure I-2) that would provide a positive containment system that would prevent process water from entering the groundwater system and being lost to the circulation system.

Three phase power will be provided by the Big Flat Electric Co-op of Malta. Power exists to the town of Landusky at this time. The BLM has approved a utility corridor across its lands for a buried cable to the leach site from the town of Landusky, a distance of approximately three quarters of a mile. In Zortman single phase overhead power exists to the plant site. One more line will be added to bring this power supply to three phase.

A 75 to 130 kw diesel generator will be maintained at each precipitation plant facility for backup power to keep the leach solution circulating in the event of electrical failure.

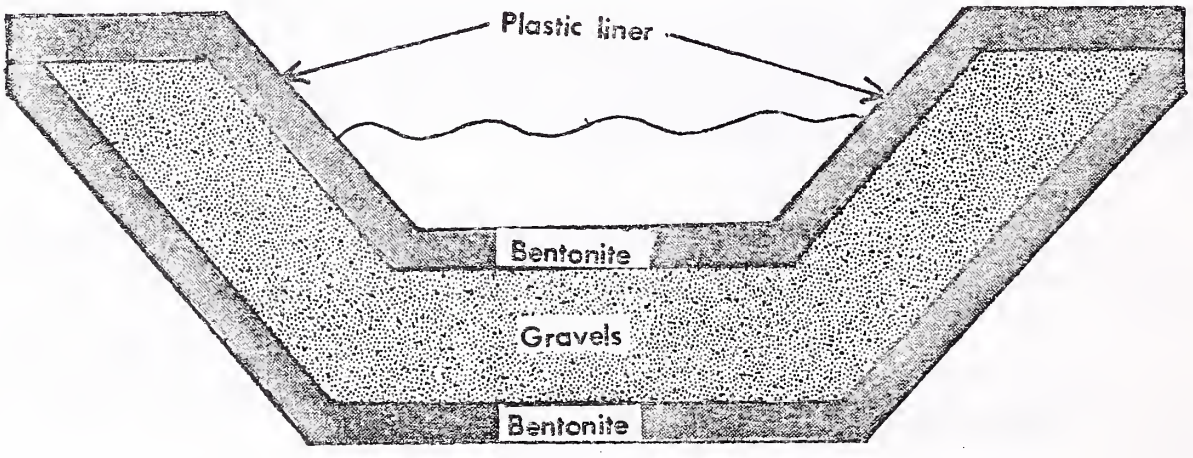



Figure I-2. Process pond lining cross-section.

### 3. Mining Sequence

The method of mining to be employed would be the same for both the Zortman and Landusky operations. The method is called "terrace benching".

Approximately 4000 feet of new road will be constructed at the Zortman mine to connect the mine with the leaching site. No new road construction would be needed at the Landusky site.

The mining involves ripping by D8 and D9 Caterpillar dozers, and blast-

ing of the ore and associated waste rock cutting in a series of benches 10' to 30' high and 30' wide reflecting the configuration of the ore body. Mining in this manner would continue around and through the existing pits widening them. As the widening involves areas not previously disturbed, the topsoil on the undisturbed areas would be stripped, stockpiled and revegetated for use in reclamation.

Waste rock or overburden would be deposited in the waste rock stockpiles (Figures I-3 and I-4).

The ore loosened during mining would be loaded by front end loaders onto two or three 35-50 ton dumptrucks and transported to the leach pad.

The Zortman pit will be opened at a lower elevation than the existing Ruby Glory Hole, probably at a smaller existing glory hole called the North Ruby Glory Hole. Mining will progress on the north, probably encompassing the old Badger King workings. Ore will be selectively mined to the limits of the ore body. The series of benches will eventually tie into the existing Ruby Glory Hole.

At Landusky, mining will begin in the old August workings. The August was an underground mine; some of the old workings (small "dog holes") have been mined through to load the pilot leach pad. The ore body is cut off by a fault structure to the north of the August and cuts back to the southwest across the mountain. An intensive drilling program is planned to further delineate the presence of the ore body past the fault structure. Existing stopes, 200' to 400' deep, will be encountered during the mining operation. These stopes will either be filled with waste, to enable continuation of mining around them, or mined through, depending on the configuration and depth of the pit when the stopes are encountered.

Acreage to be bonded and permited at the Zortman site is 274 acres. A total of 256 acres would be bonded and permited at the Landusky site. Mining and processing are estimated to continue for 18-20 years.

4. Cyanide Leaching and Value Recovery

An alkaline cyanide solution will be used to leach gold and silver from pit-run ore. The leaching solution and process, shown schematically in Figure I-5, will be applied to an ore pile (leach heap) by a sprinkler system. As the barren cyanide solution contacts the ore, it selectively complexes with gold and silver. This pregnant solution will be collected by the impervious pad underlying the leach heap, and transported to the pregnant pond. Pregnant solutions will be pumped to a precipitation press to remove gold and silver from solution. The leach pads need to contain about 15% solution, sprinkled at a rate of 5 gallons of water per square foot per 24 hour period before values are leached out of the ore. Sprinkling at a higher rate risks erosion and channelling along the bottom of the pad. The zinc filters in the press will probably be cleaned on a weekly basis. Make-up water, additional cyanide, and lime for pH control, will be added to the solution and pumped to a barren pond. The barren solution will then begin a new cycle of sprinkling, leaching, collection, and processing (Figure I-6).

It is anticipated that 1,000,000 tons of ore per year will be leached in this manner at each leach pad at full production.

At full production it is anticipated that 5,000 tons of combined overburden


Figure I-3. Zortman mining permit boundary and general facilities map.

Figure I-4. Landusky mining permit boundary and general facilities map.


LANDUSKY OPERATION
SEC 15 & 22, T25N, R24E P.M.M.
PHILLIPS COUNTY, MONTANA

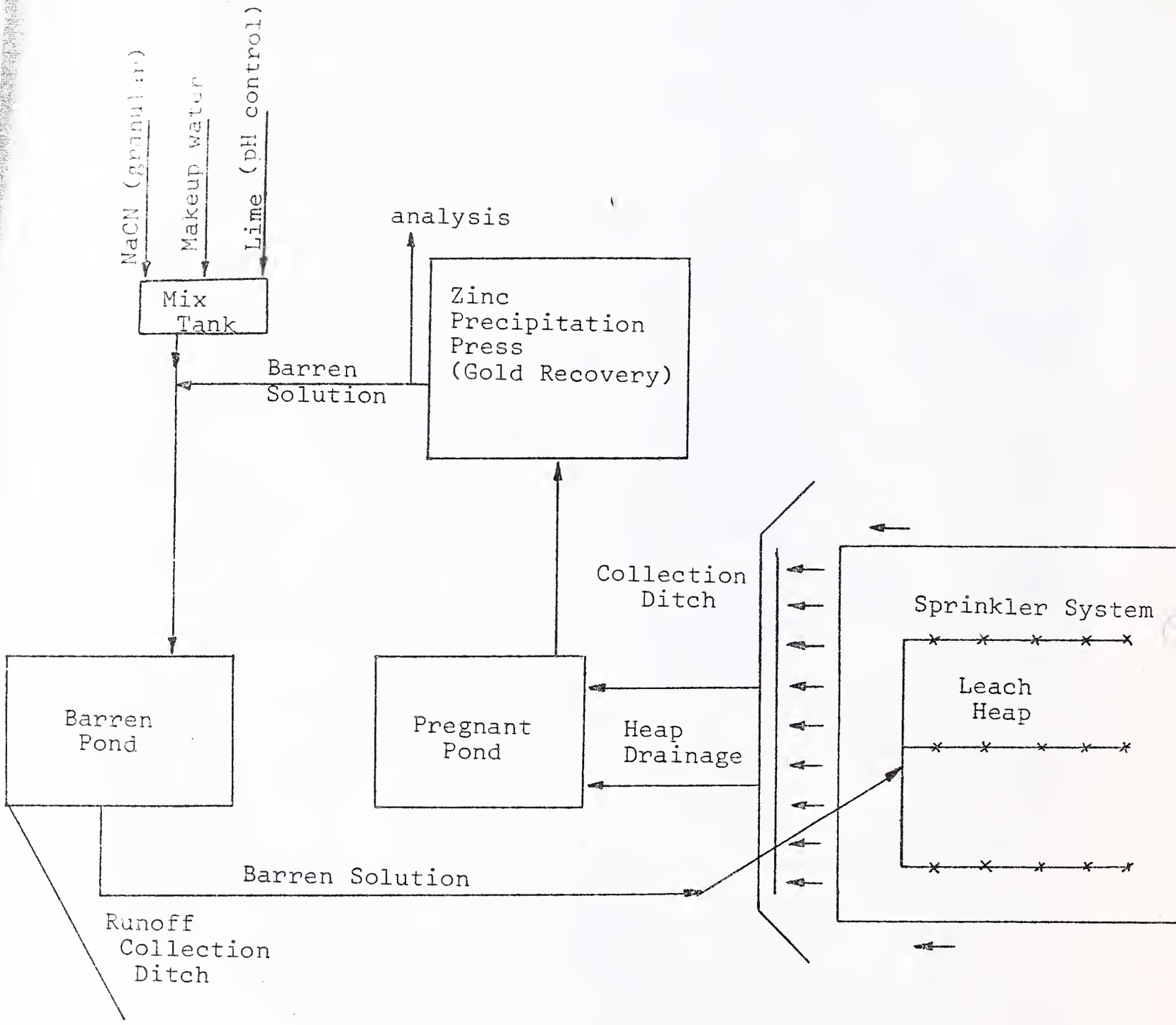



Fig. I-5. Cyanidation Process Schematic

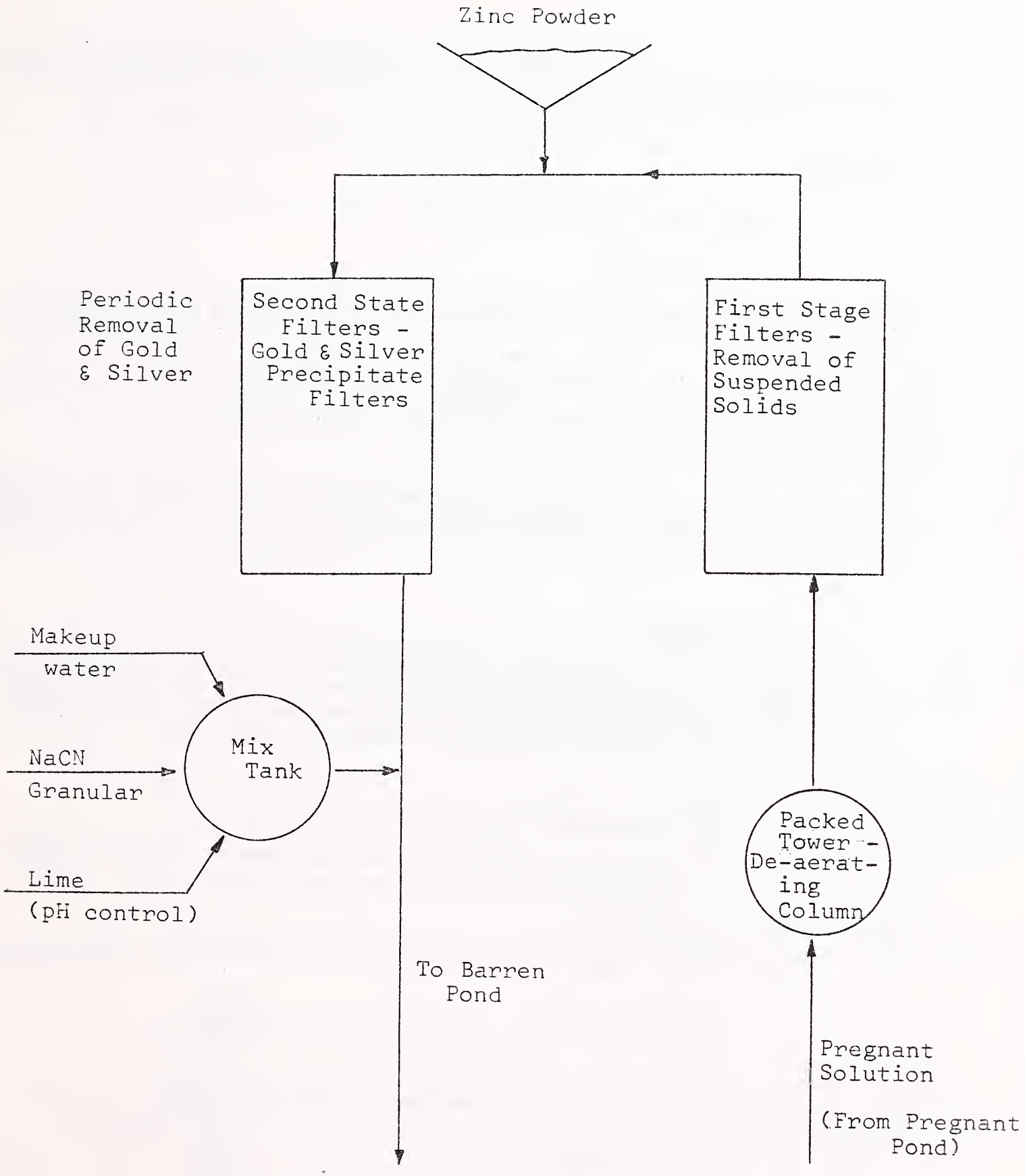



Fig. I-6. Zinc Precipitation Process for Recovery of Gold and Silver.

and ore would have to be moved per day during the mining season at each mine to supply the anticipated 1,000,000 tons per year of ore for each leaching operation.

Upon cessation of mining the final dimensions of each ore heap would be 800'x800'x40'.

5. Employment Requirements

a. Employment

Each mine would employ about 15-20 workers. Operation of the leach pad would be seasonal; it is anticipated that these workers would be absorbed into other aspects of the operation. The mining operation is expected to continue throughout the year. The mining companies state that work staff will be drawn largely from adjoining ranches and staff personnel, and that most of the hourly wage earners would be local. The supervisory and technical staff would be brought in by the operator.

Possible job positions include four people in the leach plant, heavy equipment operators (truck drivers, front-end loader operator, drilling crew, cat operator, 2 in the assay/metallurgical plant, and 5 on the senior staff). These numbers are estimations.

6. Housing

The companies have stated that they may build twelve modular or mobile homes for its technical and supervisory employees. Due to health regulations and lack of centralized sewer and water, a maximum of five houses could be sited on a five acre parcel that they presently own. However, further land acquisition is anticipated.

7. Road Development

The following information relates to road requirements for the Zortman and Landusky operations within the permit area. No upgrading of roads outside of the permit areas is contemplated.

a. Main haulage road between Zortman pit area and Zortman leach pad area.

| | | |
|---|---|---|
| 1. | New construction | 1800' |
| 2. | Upgraded existing road | 1900' |
| | Total | 3700' |

b. Access road to Zortman plant and leaching pad areas.

| | | |
|---|---|---|
| 1. | New construction | 1100' |
| 2. | Upgraded existing road | 3700' |
| | Total | 4800' |
| | Total | 8500' |

Roads will be surfaced as required with gravel from the old Ruby Gulch Mining Company operation.

c. Main haulage road between Landusky open pit (NE August area) and Landusky leach pad area.
Upgraded existing road - 6900'
(Parallel existing roads here permit one way traffic for most of this distance).

d. Approach roads to Landusky plant and leach pad area.
Upgraded existing road - 1200'

Total - 8100'

Roads will be surfaced as required with sand from the old Landusky milling operation.

## 8. Water Quality Monitoring Program

A series of sampling locations have been selected to monitor surface water quality of all drainages that could be affected by the mining or leaching process. Locations of the sampling stations are contained in the Hydrology Report prepared by WESTECH Inc. and on file in the Department's Helena office. Tentative sampling schedules and the parameters to be tested are shown in Appendix A. Springs located along stream channels will serve a dual purpose for monitoring base flow water quality and local groundwater quality.

A monitoring program has been initiated for groundwater quality near the leaching process. In the Landusky mining area a series of monitoring wells have been constructed and monitored since the fall of 1977. These wells will continue to be monitored for key parameters to indicate if any seepage is occurring from the leach pad or ponds. The Landusky monitoring well system is schematically shown in Figure I-7, and a tentative monitoring program is presented in Appendix A.

The Gold Bug adit discharge also will be sampled on a regular basis, in order to monitor its contribution to surface water quality in Montana Gulch and Rock Creek. The adit is believed to be a major groundwater discharge point for the upper portion of the Little Rocky Mountains and will provide an excellent monitoring point for groundwater quality variations, both natural and man-caused.

A tentative monitoring program has been developed for the Zortman mining area (Appendix A). The monitoring well program will reflect actual conditions once wells are in place.

## 9. Fuel and Explosive Storage

Bulk fuel storage of diesel and gasoline will be contained in tanks provided by the dealer in Malta. The area surrounding the storage tanks would be graded and protective earth berms would be built to contain any spill. The area would be kept free of vegetation as a safequard against the possible spread of fire should there be one.

The decision whether to contract blasting work or train an individual employed

NOTES:

SMW-2 Shallow Monitoring Well No. 2

IMW-A Intermediate Monitoring Well A

DMW-1 Deep Monitoring Well No. 1

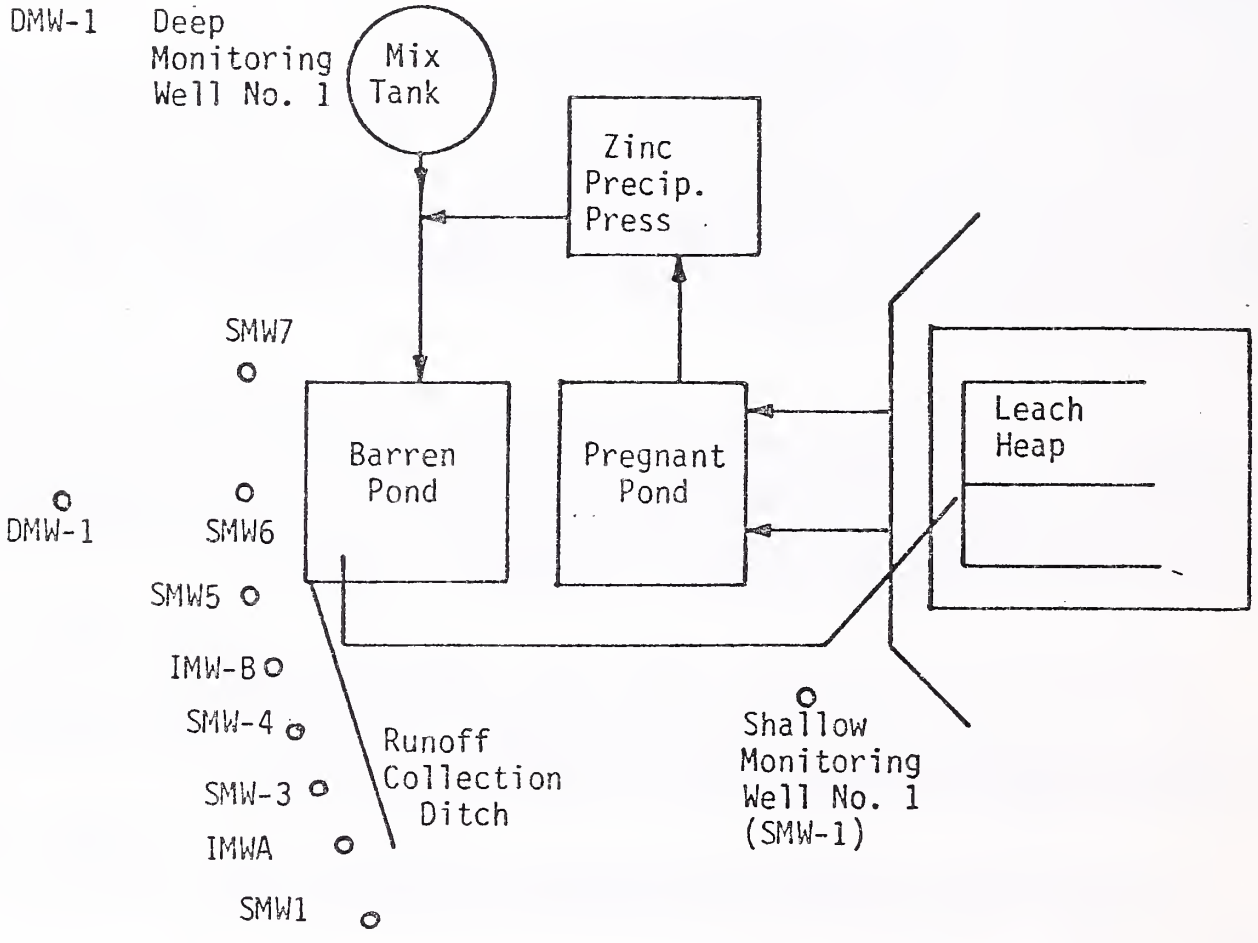



Figure I-7. Landusky monitoring wells schematic

by either mining company has not been made at this time. It is planned to use prill (ammonium nitrate and diesel fuel), prima cord, and cast primers. Blasting material will be secured in a magazine provided by the manufacturer or contract or all storage of explosives would be done in accordance with state and federal regulations.

10. Reagent Storage

Cyanide would be purchased directly from the DuPont Company in 1,000 gallon containers. Storage would follow the manufacturer's instructions regarding protection from freezing, or other precautionary measures. Cyanide containers would be stored in secure areas at the plant sites, or within the locked facilities at the Zortman laboratory.

Lime would be kept in a locked storage shed at the mine site. Lime would be added to loaded ore trucks before the ore is hauled to the leach pads. Ore trucks would drive under a hopper or similar structure for the addition of lime to the ore.

Caustic soda would be stored in a locked building at the precipitation plant. This compound is added to the process water at the mix plant.

11. Surface Water Control

Surface water in the vicinity of the operations will be protected and controlled as follows:

1. The leach heaps will be placed upon an impervious clay pad with drainage to the pregnant ponds (See Figure I-5).

2. The barren and pregnant ponds will be lined with an impervious clay pad overlain by a membrane liner for positive solution containment.

3. The leach heaps, ponds, and zinc precipitation unit will be protected from surface runoff by berms. Adequate storage will be available to store runoff from disturbed areas for the 10-year 24-hour precipitation event.

4. The leach operations will be a closed-cycle operation with no discharge of solution waters. Water lost to evaporation will be replaced as needed to ensure a continuous operation.

5. In the event a pipe or pump failure, the solution will be deflected by berms, directed into the barren pond. Berms will also be constructed around the barren pond to contain any possible failure. No solution will be permitted to leave the area by overland flow; all drainage is bermed into retaining ponds.

6. Surface water will be diverted around the area of active pit, facilities, and any new construction sites resulting from these operations. Properly constructed culverts, conduits or other artificial channels to carry divert surface waters will not be causes of pollution and unnecessary erosion.

7. An emergency storage pond has been constructed at the Landusky site which

will be capable of storing any overflow from the Landusky ponds, or in case of pond liner failure. This emergency pond is located above the Gold Bug adit and will hold slightly over a million gallons (three (3) acre feet) of solution storage. The pond will be lined with 36 mil. hypalon liners, reinforced on 5 by 5 centers, and covered with sand. The rectangular pond will be enclosed by a six (6) foot hog wire fence to control access. The solution will be pumped to the storage pond back through the existing water line which runs from the Gold Bug adit to the process plant. This line will be controlled by a T valve. (Figure I-8).

8. Upon abandonment, leach pads will be graded to prevent excessive erosion. Available topsoil will be placee over the leached-out ore prior to the initial revegetation attempt. Adequate drainage of precipitation will be provided to prevent seepage of excess water into the leach heaps and possible resulting acid drainage problems.

9. Upon abandonment, water from the development or mining activities will be diverted or treated in a manner designed to contol siltation, erosion or other water pollution damage to streams and natural water courses.

12. Water Discharge

The proposed operations would have no discharge of water, as the leaching operations is a closed circuit system. A Montana Pollution Discharge Elimination System Permit (MPDES) is being applied for by the mining companies in the event that an emergency situation could require a discharge be made at some time during the life of the project. In the event that the mines encounter more subsurface water then anticipated, any treatment and discharge of mine waters would be required to comply with all state and federal regulations.

13. Dust Control Measures

The mining companies propose to utilize, at a minimum, the following methods to control dust:

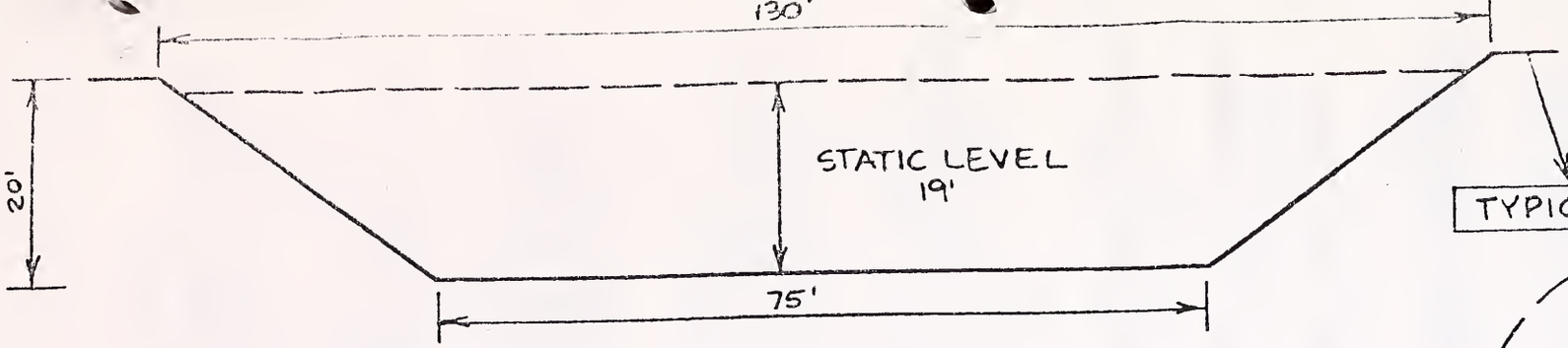
1). Vehicle speeds will be reduced.

2). Trucks will not be loaded in such a manner that ore would be lost, to create crushed ore dust on the road surface.

3). The operator will curtail the use of haul roads during unfavorable meteorological conditions, if haul roads become signigicant sources of dust.

4). The operator will use equipment present on the site to clear haul roads if dust producing material, such as spilled ore or overburden materials, presents a hazard to air quality.

5). When the above control measures prove ineffective to suppress dust emissions from haul roads, the operator will sprinkle the haul road using a sprinkler truck with a 1,000 gallon tank.




SIDE

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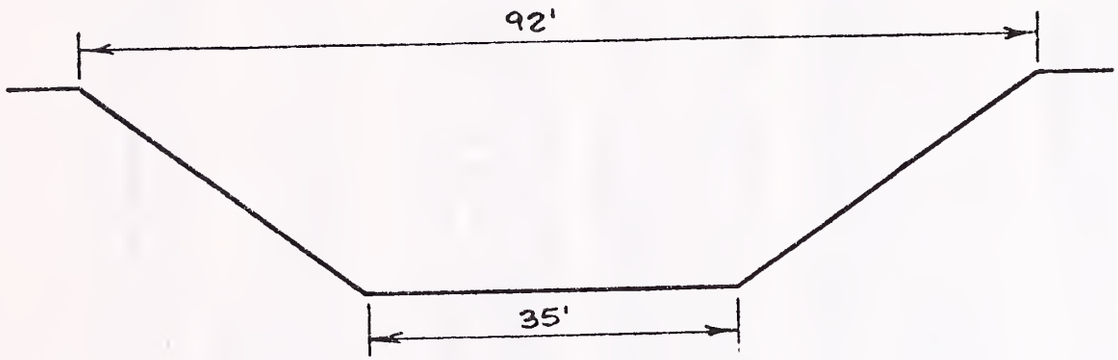


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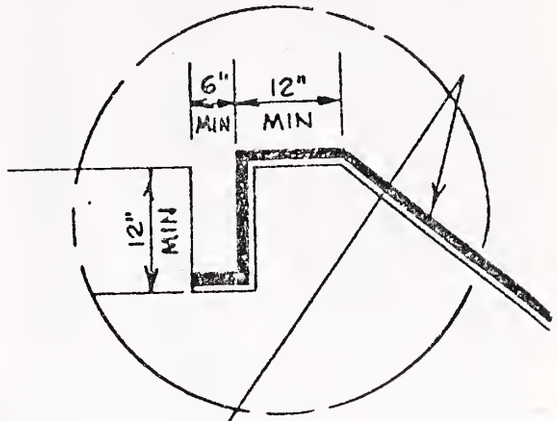
SCALE: 1" = 20'

TYPICAL BURIAL TRENCH




EXPOSED LINER

NO SCALE

LINER MATERIAL

WATERSAVER HYPALON
36 MIL (.036 INCH)
REINFORCED

Figure I-8. LANDUSKY MINING INC.

CONTINGENT WATER STORAGE PLAN

VOLUME U.S. GALLONS

CRITERIA

1/2 AREA TOP + 1/2 AREA BOTTOM
× STATIC LEVEL × 7.481 = U.S. GALLON

5980 + 1312.5 × 19 × 7.481 = 1,036548.7

VOLUME = 1,036000 U.S GALLONS

NOTE:

1. ALL SIDE BERMS WILL BE GRADED TO FACILIATE ANY NATURAL WATER SHED
2. ONE SIDE AND END ARE DIRECTED TO UNDISTURBED HILLSIDE
3. THE OTHERS HAVE NO LESS THAN 2C' OF FREEBOARD (COMPACTED) FOR POND STABILIT'
4. A 6' HOG WIRE FENCE WITH ONE LOCKED ACCESS GATE WILL BE CONSTRUCTED AROUND THE ENTIRE POND PERIMETER.

14. Reclamation Plan

a. Mine Sites

Prior to reclamation, Zortman Mining Inc. and Landusky Mining Inc. will submit to the Department for review and approval, reclamation plans and post-mining contour maps.

No backfilling of the mine pits is anticipated. The pit walls will be mined by terrace benching. When the project is complete, final walls will be benched, the floor sloped and revegetated.

Upon cessation of mining, pit floors will be sloped and graded in such a manner as to prevent the accumulation of stagnant water. The waste dump regraded surface will be sloped, preventing the formation of ponds.

Upon partial or complete saturation of water, graded fill, tailings or spoil slopes will be stable.

The graded spoil material will be spread with salvaged topsoil and the seedbed prepared.

All slopes will be returned to approximate original contours, or the equivalent, when possible.

b. Leach Sites

When the mining operation is complete, the leach pads will be rinsed with water. The amount of time and number of gallons needed to rinse the pads will depend upon how rapidly the solution percolates through the ore material.

Rinse water in the ponds will be evaporated. The pond water at this point will have been circulated, so that no toxic materials are left. Once the water has evaporated from the ponds, the hypalon membrane will be broken and the dam on the downhill slope of the pond breached. This action will prevent the accumulation of any snowmelt or rainfall during the grading and revegetation process.

The hypalon membrane and nontoxic residues in the bottom of the pond will be buried during the grading procedure. The retaining dam on the downhill side of the pond, the sides and pond floor, will be graded to the approximate original contour of the site. When grading is complete, the area will be spread with available topsoil and revegetated.

All buildings and associated structures and equipment will be dismantled and removed from the sites.

c. Revegetation

Broadcast seeding will be utilized for reseeding. The areas will be raked according to SCS and Departmental recommendations. Species to be used are listed in Appendix B.

The seeding recommendations given above are compatible with the proposed reclaimed land usage for recreation and wildlife habitat. Should the initial seeding attempt fail, the company will seek the advice of the Department prior to making another attempt. Recommendations from the Department will be incorporated should a second attempt be necessary.

d. Other

In addition to the reclamation plans discussed previously, the following plans for mitigating measures would be conducted concurrently with the construction and operation of the proposed project.

1). All water, tailings or spoil impounding structures would be equipped with spillways or other devices that would protect against washouts during a 100 year flood.

2). All refuse would be disposed of in a manner to prevent water pollution or deleterious effects on revegetation efforts. The Zortman and Landusky Mining Companies would comply with applicable county, state and federal laws regarding solid waste disposal.

3). If construction of earth dams or other devices to control water drainage would become necessary, such structures would not interfere with other landowners' rights or contribute to water pollution.

4). Upon abandonment, water discharge from the development or mining activities would be diverted or treated in a manner to control erosion, siltation or other water pollution to streams and natural water courses.

5). All access, haul and other support roads would be located, constructed and maintained to control or minimize channeling and other erosion.

6). All operations would be conducted to avoid forest fires and spontaneous combustion.

7). Should any archaeological or historical sites be found during development, excavation would cease and the sites would be given appropriate protection.

8). Stagnant water which could become a breeding ground for noxious insects would not be allowed to accumulate in the mine or plant area.

9). All final grading for reclamation would be made with nonnoxious, nonflammable and noncombustible solids.

10). Proper precautions (such as use of water truck to water roads, if necessary) would be taken to assure that wind erosion on exposed cuts, or spoil disposal areas would not become a public nuisance or detriment to local flora and fauna.

15. Performance Bond

The Hard Rock Law (Title 50, Chapter 12, R.C.M. 1947) states:

*The applicant shall file with the department a bond payable to the state of Montana with surety satisfactory to the department in the penal sum to be determined by the department of not less than twenty-five hundred dollars ($2,500) for each acre or fraction thereof of the disturbed area, conditions upon the faithful performance of the requirements of this act and the rules of the board. In lieu of such bond the applicant may file with the board a cash deposit, an assignment of a certificate of deposit, or other surety acceptable to the board. Regardless of the above limits, the bond shall not be less than the estimated cost to the state to complete the reclamation of the disturbed land. A public or governmental agency shall not be required to post a bond under the provisions of this act. A blanket performance bond covering two (2) or more operations may be accepted by the board. Such blanket bond shall adequately secure the estimated total number of acres of disturbed land. When determined by the department that the set bonding level of a permit or license does not represent the present costs of reclamation, the department may modify the bonding requirements of that permit or license.*

*No bond filed in accordance with the provisions of this act shall be released by the department until the provisions of this act, the rules adopted pursuant thereto and this reclamation plan have been fulfilled.*

At the time of preparation and publication of this statement the bonding level of these proposed mining operations has not been determined.

16. Future Expansion

Landusky Mining Company has indicated that approximately 530 acres would represent the "life of the operation" as compared to 256 acres being applied for with the present operating permit application. The Zortman Mining Company has indicated that approximately 403 acres would represent the "life of the operation" as compared to 274 acres presently being applied for in an operating permit. If, in the future, the mines and/or mill sites would require expansion beyond the proposed permit boundaries, the mining companies would apply to the Department for an amendment to their operating permits. If the expansion is outside of the designated "life of the operations" areas, the companies would be required to apply for additional operating permits.

There have presently been no plans developed regarding possible expansion of the operating permit areas by either mining companies. At such time as this information may be available, and prior to departmental action upon any future amendment requests, an additional environmental review of the proposed expansion would be required.

## B. Proposals for Other Developments in the Area

Major pipeline construction projects are underway which will connect the Bowdoin Gas Field with out-of-state markets. Between 120 and 150 persons are being employed in summer months during this project. The pipeline construction

has served to temporarily improve local economies and stabilize local populations in the Malta area.

More long-term economic stimulation is likely to result from development of the area's bentonite resource. American Colloid Company has obtained 620 acres of land south of Malta and intends to strip mine 250,000 tons of bentonite annually. The bentonite will be processed in a $2 million plant which is currently under construction near Malta. Initially the company is employing about a dozen persons, but as production is increased in the early 1980's 45 to 50 people will be employed in mining operations and an additional 60 to 70 will work in the plant.

With the exception of the Zortman-Landusky mining project, there are no other major industrial developments being contemplated for Phillips County. A project which might have significant, but only short-term, effects on the local economy is the Northern Tier Pipeline. Phillips County is located on one of the pipeline's three alternative routes.

### C. Existing Mineral Mining in the Area

#### 1. Mineral Claims

Currently there are numerous mining claims, both patented and unpatented, in the Little Rocky Mountains. Zortman and Landusky Mining Companies holdings are all patented claims.

#### 2. Mineral Mining

The Little Rocky Mountains have experienced considerable mining activity in the past; however, there is no mining being conducted at the present time with the exception of the Landusky Mining Company operation under their Small Miner Exclusion Statement.

## II. DESCRIPTION OF THE EXISTING ENVIRONMENT

### A. The Physical Environment

#### 1. Location and Description of the Areas

The proposed mine permit areas are located in Phillips County in the Little Rocky Mountains of north central Montana. Figure I-1 shows the geographical relationship of the study area to the Missouri and Milk Rivers. The proposed mine locations are approximately 50 miles southwest of Malta and 110 miles northeast of Lewistown, Montana

#### 2. Topography

The Little Rocky Mountains in southwestern Phillips County became a prominent landmark as a result of intense geologic activity, and hosted igneous intrusions which split and deformed surrounding sedimentary formations. The tertiary period followed with continued uplift and rejuvination; stream development was significant and many of the alluvial aquifers were deposited.

The eastern slope of these mountains extends into the western portion of Phillips County. The general topography of these slopes is rough rolling to steeply eroded ridges and fans.

Elevations on the study area range from 3600 feet on the prairie (southeastern corner) to about 5,700 feet on the highest central peaks. Overall topography is rugged with some slopes exceeding 100 percent.

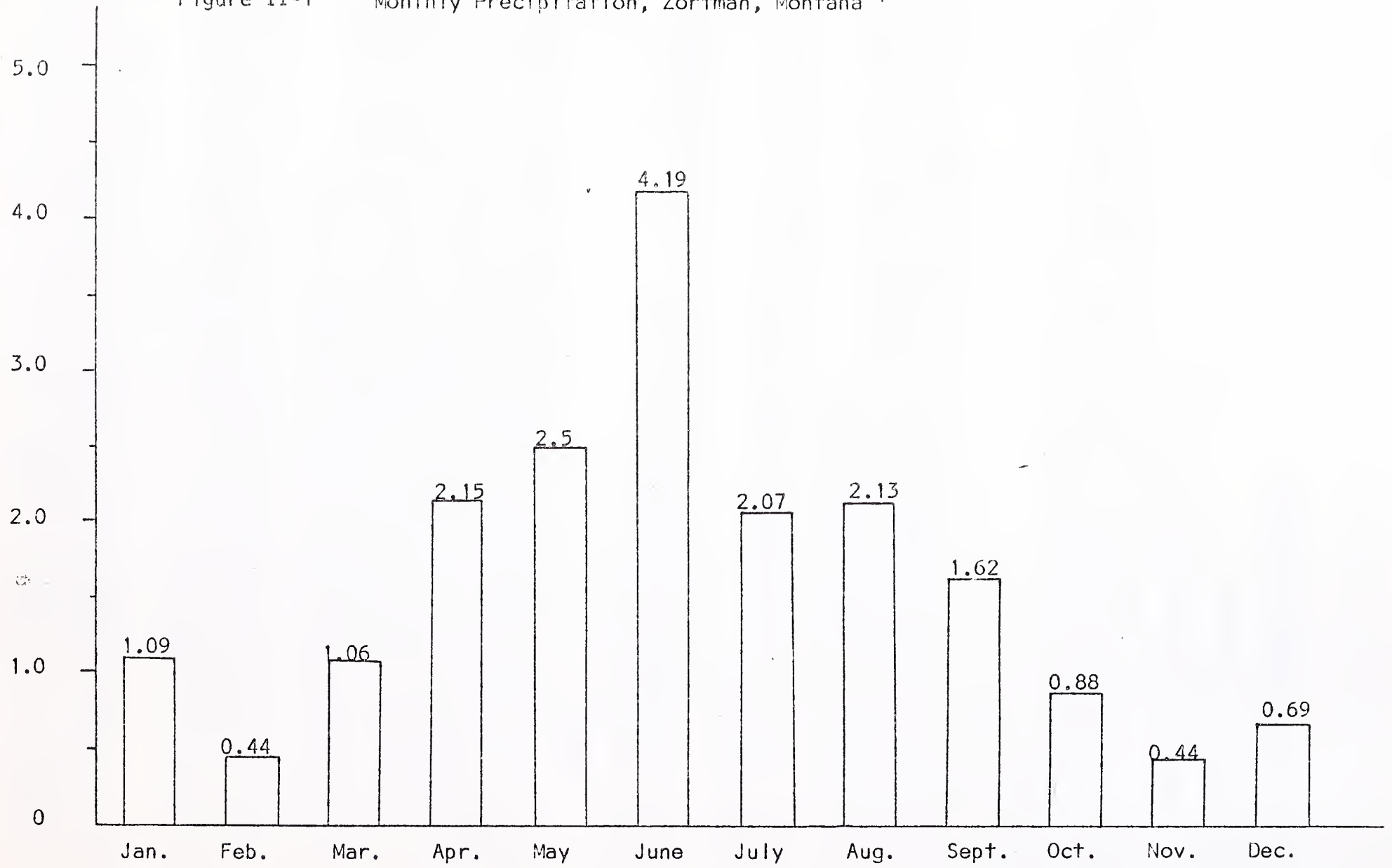
#### 3. Climate

Climatic data for the Little Rocky Mountains has been recorded at Zortman and Hays, Montana, representing conditions at lower elevations. No data has been recorded for upper elevations of the area. Climatic parameters will vary with elevation. Monthly precipitation for Zortman, Montana is shown in Figure II-1. Mean annual precipitation is 19.2 inches at Zortman and 14.3 inches at Hays, (NOAA, 1966-1976). At Zortman 34% of the annual precipitation occurs in May and June with an additional 22% in July and August. Annual snowfall represents about 30% (5½-6 inches) of total precipitation and generally occurs from October through April with occasional light snowfall in May and September. Higher elevations undoubtedly receive additional precipitation and higher snowfall.

The average length of the frost-free season is 70-100 days with the first freeze generally occurring between August 23 and September 5 and the last freeze between May 30 and June 19 (Caprio, 1965 a, b, c). Mean monthly temperature at Zortman varies from 17.2°F in January to 67.1°F in August with an annual mean temperature of 41.7°F.

Mean wind speed is greatest during the months of January through April. Maximum wind speeds occur in June and July, associated with thunderstorm activity. Prevaling wind direction is from the northwest. Maximum wind velocities tend to decrease from west to east; Havre to Glasgow. Short duration peaks of 50+ m.p.h.

Figure II-1 Monthly Precipitation, Zortman, Montana [1]




[1] Data gathered from September, 1965 to present

can be expected. The persistent winds during the winter months means that the snowpack is drifted into depressions and drainages.

Lowest levels of relative humidity occur from late morning to late afternoon in the months of May through September. This is conducive to higher evapotranspiration rates. Conversely, the higher levels of humidity during the winter months tend to reduce snowpack sublimation rates. (Department of Natural Resources and Conservation).

4. Air Quality

No air quality sampling program was conducted at either of the proposed permit sites. It is assumed that ambient air quality is similar at these sites to other rural rangeland areas in northcentral Montana.

5. Geology

A wide variety of geologic formations ranging in age from Precambrian to Recent are present in Phillips County. The county's geologic history includes long periods of sedimentation and erosion punctuated by uplift and structural deformation. All metallic mineral production in Phillips County has come from the Little Rocky Mountains district in the Landusky-Zortman area.

The Little Rocky Mountains appear out of place on the plains of northcentral Montana nearly 200 miles east of the Rocky Mountains. This isolated structure is an example of the mountain building processes that are in part responsible for the formation of the Rocky Mountains. Some 50-100 million years ago, in the evolution of the Rocky Mountains, scattered bodies of molten granite squeezed into the existing country rock. In some cases as magma migrated up a vertical fracture it would reach a zone where it was easier to spread horizontally between the existing sedimentary layers rather than proceed vertically. This type of intrusion resembles a gigantic mushroom. Such is probably the case with the Little Rocky Mountains.

This shape of intrusion is called a lacolith. The bottom, which is fed by a vertical dike, is usually flat and follows the bedding plane of the sedimentary layers. The top is upwardly convex, creating the roof of the mushroom structure.

The actual structure of the Little Rocky Mountains is much more complex (Figure II-2). Zones of greater magma uplift created numerous domes in the roof of the lacolith and overlying sedimentary rocks. Faulting and folding have further complicated the mixing of intrusive and sedimentary rocks.

The overlying sedimentary rocks were domed as the molten mass entered. Erosive processes have removed a portion of the overlying rocks exposing the central portions of the lacolith and creating the existing topography and geologic setting of the Little Rocky Mountains.

The molten granitic magma (granite-syenite prophyry) after its emplacement began to cool and eventually solidified. Further contraction caused numerous fractures to develope. Contemporaneous with this fracturing or shortly thereafter hot aqueous mineral ladden solutions entered the fissure cracks. These hydrothermal solutions carried silica and precious metals (gold-silver). Mineralized quartz

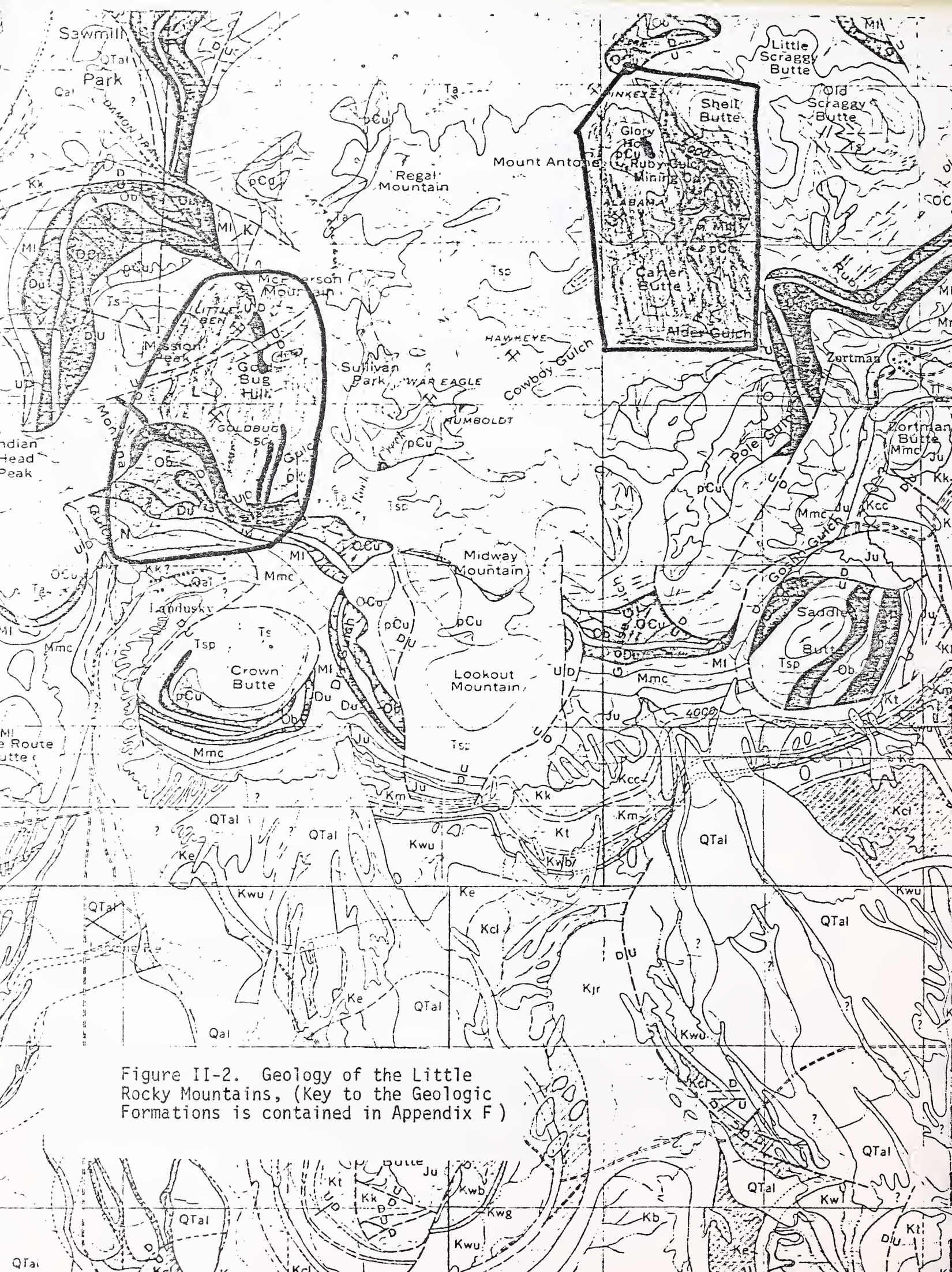



Figure II-2. Geology of the Little Rocky Mountains, (Key to the Geologic Formations is contained in Appendix F )

is what remains of these hydrothermal solutions.

These vein lode deposits were first discovered in the Little Rocky Mountains in 1893. Erosion of the lacolith and associated mineralized veins created placer deposits, the first of which was found in 1894.

Gold in the Little Rocky Mountains is often associated with pyrite (fools gold) and limonite and also occurs as free grains. Gold and silver ore is also found bound to the element telluride probably in the form of sylvanite ((Au, Ag) $Te_2$) minerals which often appears to resemble written characters (Montana Water Resources Board, 1968).

More detailed information on the geology of the area is on file at the Department's Helena office.

### 6. Soils

A soil survey was conducted at the proposed Zortman and Landusky mine and leach sites during the summer of 1978 by WESTECH Inc. A soils map of each site was produced (Figures II-3, and II-4). Depth and suitability ratings of these soils for use as topsoil for reclamation purposes are found in tables II-1 and II-2.

A complete discussion of the soil survey and survey data can be found in the report prepared by WESTECH Inc. and on file in the Department's Helena office.

The soils are generally associated with a shale substratum within an approximate 36" depth, they may be either alluvial or residual in nature. The soils vary from a medium to heavy texture which is very sticky when wet and high in alkali. The beneficial use of this land is for livestock grazing, recreation and wildlife habitat. (BLM Unit Resource Analysis).

Colluvial soils are formed from deposits of rock and soil which have accumulated at the foot of slopes either by gravity or stream action. The southern slopes of the Little Rocky Mountains have colluvial materials which consist largely of sedimentary rocks such as limestone; igneous and metamorphic. The more gently slopes have bench-like formations standing out prominently above the deeply entrenched stream courses, which have eroded the mountain sides.

The surface soil of the gentle slopes is gravelly, a rich to dark brown, friable loam to a depth of 5" to 6". The subsurface layer is a darker brown, calcareous, compact, heavy loam grading below 12" to 16" into a friable silty clay loam. More or less lime-coated gravel and rock are found in all layers but become more abundant with depth. These soils are considered favorable for cultivation; however, the benches are rather narrow for extensive farming.

In a publication by Southard (1973) the Little Rocky Mountains are within the Hughesville-Woodhurst Association. The following is a description of that soil association:

HW Hughesville-Woodhurst Association:

This soil association occurs on moderately steep and steep slopes of the Little Rocky Mountains. Included soils are Spring Creek and Blaine. These areas are used

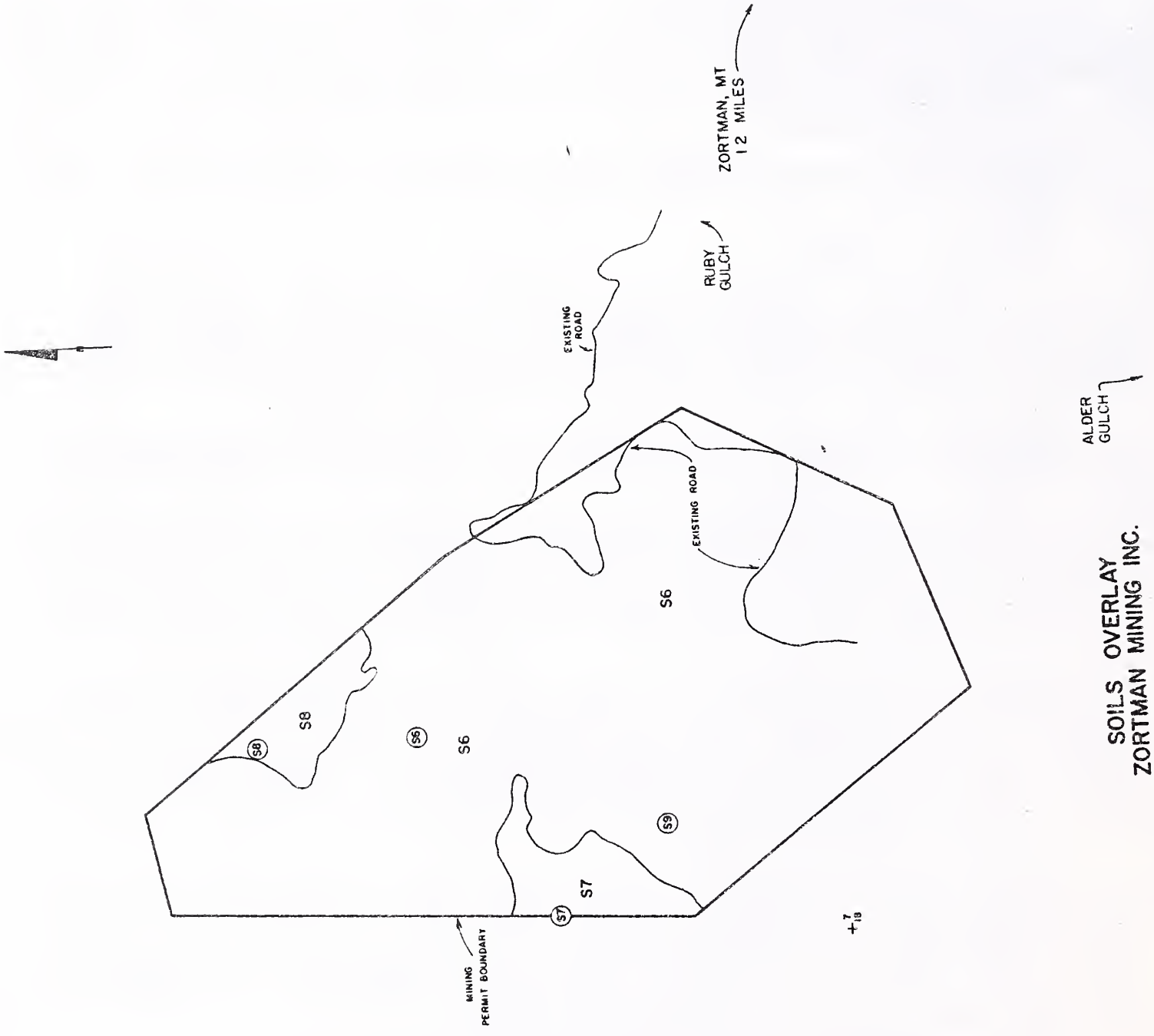



Figure II-3. Zortman Permit Area soils map.

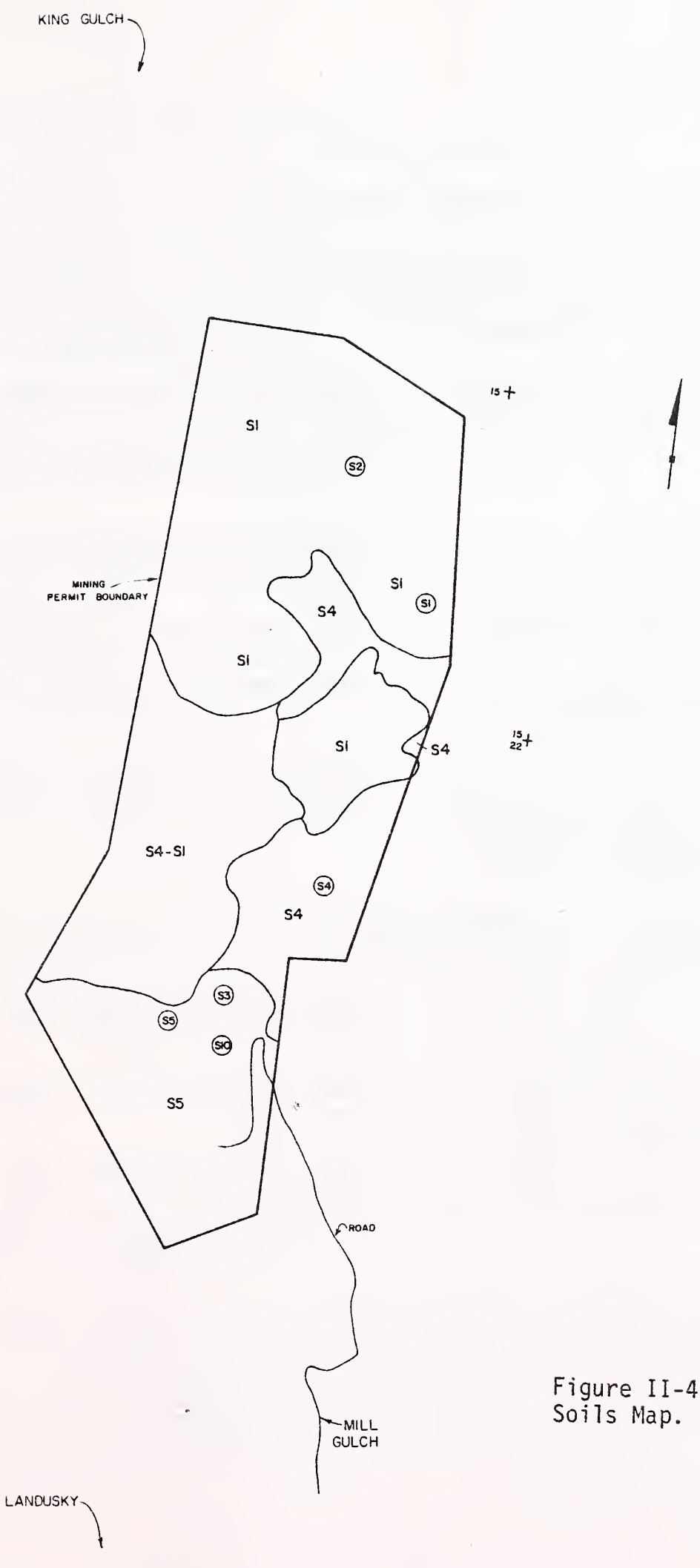



Figure II-4. Landusky Permit Area Soils Map.

SOILS OVERLAY
LANDUSKY MINING INC.

## Classification of Series

### Landusky Mine

| Series | Symbol on Map | Family and Subgroup |
|---|---|---|
| S1 | S1 | Loamy skeletal, mixed, Typic Cryochrepts |
| S3 | S3 | Loamy skeletal, mixed, Typic Cryoborolls |
| S4 | S4 | Loamy skeletal, mixed, Typic Cryoborolls |
| S5 | S5 | Fine loamy, mixed, Typic Cryoborolls |
| S10 | S10 | Fine loamy, mixed, Typic Cryoborolls |

### Zortman Mine

| | | |
|---|---|---|
| S6 | S6 | Loamy skeletal, mixed, Typic Cryochrepts |
| S7 | S7 | Loamy skeletal, mixed, Lithic Cryochrepts |
| S8 | S8 | Loamy skeletal, mixed, Typic Cryoborolls |

for grazing and some timber production.

Soil series within the Hughesville-Woodhurst Association:

Blaine soils are developed on stony deposits (from basic and intermediate igneous rocks). The surface soil is a stony clay loam lying on a very stony clay subsoil. The gravels and stones make up 80 percent by volume of the subsoil and substratum. A lime zone is usually present at a depth of 15 inches. Hard bedrock is encountered at depths greater than 40 inches. They occur on rolling and steep landscapes. Associated soils are Brownless, Duffy and Spring Creek.

Spring Creek soils are developed on igneous and metamorphic rocks. The surface soil is a brown, granular, gravelly loam. The lime zone occurs at about 5 inches and bedrock at about 12 inches. These soils occur on steep and broken slopes with gradients in excess of 15 percent. Associated soils are Stecum and Blaine.

| Symbol on Map | Included Soils | Depth of Regolith | Qualitative Rating |
|---|---|---|---|
| S6 | | 84"+ | Fair to 17". poor below due to extremely cobbly soil |
| | S7 | 17" | Fair to poor down to bedrock depending on content of coarse fragments at the site |
| | S8 | 84"+ | Good in some areas to 9", but generally fair to 28" due to coarse fragments: poor below due to extremely cobbly soil |
| S7 | | 17" | Same as S7 above |
| | Rock Outcrop | | Unsuitable |
| S8 | | 84"+ | Good in some areas to 9" but generally fair to 28" due to coarse fragments; poor below due to extremely cobbly soil |

Table II-1. Depth and Suitability of Soil Materials for Use as Topsoil at Zortman Site.

Note: The content of coarse fragments throughout the soils vary considerably within short distances. These variations cannot be mapped; however, they do occur so caution and judgement should be exercised while stripping topsoiling material. The soil series, as described, represents the modal concept.

| Symbol on Map | Included Soils | Depth of Regolith | Qualitative Rating |
|---|---|---|---|
| S1 | | 60"+ | Fair to 8", poor below due to extremely cobbly material |
| | S2 | 60"+ | Fair to 10", poor below due to extremely cobbly material |
| | S4 | 70"+ | Fair to 26", poor below due to extremely cobbly material |
| S5 | | 32" | Good to 7", fair below due to high lime |
| | S3 | 18" | Good to 7", fair to 12", poor below due to extremely gravelly material |
| | S10 | 60"+ | Good to 7", fair below due to high lime |
| S4 | | 70"+ | Good to 26", poor below due to extremely cobbly material |
| S4-S1 | | 60-70' | Refer to ratings for S4 and S1 above |

Table II-2. Depth and Suitability of Soil Materials for use as Topsoil at Landusky Sites.

Note: The content of coarse fragments throughout the soils varies considerably within short distances. These variations cannot be mapped; however, they do occur so caution and judgement should be exercised while stripping topsoiling material. The soil series, as described, represents the modal concept.

7. Water Resources

a. Surface water quantity

Both proposed permit areas are located on a drainage divide between the Milk and Missouri Rivers (Fig. II-5). The major drainages involved include Rock Creek, Montana Gulch, Mill Gulch, King Creek, Ruby Gulch, Alder Gulch and Lodgepole Creek.

A hydrologic investigation has been conducted in the Little Rockies since the fall of 1977 by WESTECH Inc. The comprehensive hydrology report by WESTECH Inc. was used as the basis for hydrologic information presented in this EIS and is on file in the Department's Helena office. No other formal investigation is known to exist for this area. The comprehensive field investigation has attempted to develop baseline data for specific stream segments that may be influenced by the Landusky and Zortman mining developments, to develop an understanding of water

T. 26 N.

T. 25 N.

T. 24 N.

BLAINE COUNTY
PHILLIPS COUNTY

SEASONAL ROAD
PRIMITIVE ROAD
TRAIL
RAILROAD
B.L.M. OFFICE
LOOKOUT STATION
RECREATION SITE
U.S. INTERSTATE HIGHWAY
U.S. HIGHWAY
STATE HIGHWAY
B.L.M. ROAD SYSTEM
IR Indian Reservation
V Vacant Public Land
P Private
M Military Reserve

# LITTLE ROCKIES PLANNING UNIT 01-12

## PHILLIPS RESOURCE AREA

MONTANA
1969

SCALE: 1" = 1 MILE

1 ½ 0 1 2 3Mi.

| REVISIONS | |
|---|---|
| PLANIMETRY | |
| STATUS | |

Figure II-5. Surface Water Map.

quality dynamics in ground surface water systems, and understand potential effects of the proposed developments.

### (1) Landusky area

#### (a) Rock Creek

The southern portion of the Landusky Mining area is drained entirely by Rock Creek and its tributaries. Rock Creek, in turn, is a tributary of the Missouri River located approximately 22 miles southeast of Landusky. The upper portion of Rock Creek is ephemeral with a narrow steep channel composed of gravels, cobble, and occasional brush jams. Below the confluence of Montana Gulch, Rock Creek becomes intermittent and contains numerous beaver dams. The stream channel is ponded for most of the distance between Landusky and the Little Rockies Camp. (24N24E2BDBB) The segment of Rock Creek between Montana Gulch and the Little Rockies Camp carries a sustained base flow, but during unusually dry years it ceases to flow for short segments. The base flow is a combination of Gold Bug adit water (Montana Gulch), springs located on the Kolczak Ranch and springs near the Little Rockies Camp. Rock Creek is a perennial stream below the Little Rockies Camp. Major tributaries to upper Rock Creek include Montana Gulch and Mill Gulch, which drain the major portion of the Landusky mining area.

#### (b) Montana Gulch

Montana Gulch is an ephemeral, steep drainage in its upper reaches, and at its confluence with the Gold Bug adit discharge becomes perennial. Several beaver dams exist in the middle segment of Montana Gulch. These tend to retard the velocity of flow causing a small amount of sedimentation. The streambed in the middle and lower portions of Montana Gulch varies from bedrock to fine sandy sediments originating from mine dumps. The Gold Bug adit discharge, while essentially a groundwater source, is an important factor in surface water hydrology in the Landusky area. A relatively constant flow, between 0.75 and 1.5 cfs, constitutes the majority of the base flows in Montana Gulch and Rock Creek for a distance of approximately three miles.

#### (c) Mill Gulch

Mill Gulch is an ephemeral stream in its upper and lower reaches but has a middle segment that is intermittent. An alluvial spring, flowing about five to ten gallon per minute for most of the year, causes Mill Gulch to flow for about 1,000 feet before infiltrating into the creek bed gravels during high water flow seasons. Mill Gulch is steep for most of its length, attaining a relatively flat gradient at its confluence with Rock Creek at Landusky. The channel is typically narrow with a bed consisting of gravels, cobble, boulders, and occasionally bedrock.

#### (d) King Creek

King Creek is the only drainage system flowing northward from the Landusky mining area. Its upper segment is steep, ephemeral, and intercepts a number of past mining disturbances, including the August Mine, waste dump tailings, and associated roads. During high flow periods King Creek and its smaller tributaries actively erode the tailings, leaving steep, nearly vertical walls as much as 40 feet high in places. These walls are constantly sloughing and are easily washed away

during subsequent high flows. During several investigations in 1978 the toe of the tailings, adjacent to King Creek, was wet, suggesting that the tailings store and transport a significant amount of moisture. This same assumption could be made for the King Creek channel which is composed of tailings as much as four feet thick in places. An investigation in October 1978 by WESTECH Inc. showed that King Creek was flowing about 20 gallons per minute as it entered the Fort Belknap Indian Reservation, and that tailings are a significant part of the stream channel well into the reservation.

(2) Zortman area

(a) Ruby Gulch

The proposed Zortman mining area is drained on its southern slopes by two streams Ruby Gulch and Alder Gulch, which join just below Zortman. Ruby Gulch then flows south to CK Creek, which is a tributary of the Missouri River approximately 30 miles southeast of Zortman.

Ruby Gulch is characterized as an intermittent stream in its upper reaches and immediately below a large accumulation of mill tailings. During an investigation in October 1978 by WESTECH Inc., there was approximately 30 gallons per minute flowing in each of the two forks of Ruby Gulch just below the old mining town of Whitcomb (25N25E7). This flow disappears into gravelly tailing and reappears below the major mass of tailings below the old cyanide mill. The large accumulation of tailings is capable of storing large amounts of precipitation and discharging it to Ruby Gulch as a relatively constant flowing spring. During an unusually wet May in 1978, this spring flowed approximately one cfs while in October this flow had decreased to about 50 gallons per minute (0.1 cfs). Flows as high as the May flow only travel a short distance before disappearing into the Ruby Gulch channel, composed entirely of tailings.

Ruby Gulch is almost always dry at Zortman, and flows only during extremely high precipitation events. One such event was observed in September 1978 when 3.4 inches of rain fell within two days, causing Ruby Gulch to have a substantial flow and moving great volumes of tailings. There was very little flow response to precipitation in upper Ruby Gulch due to the huge storage capacity of old mill tailings. Below Zortman, Ruby Gulch gradually changes in character from a channel composed entirely of tailings to a grass-covered stream typical to the plains area. This lower reach of Ruby is ephemeral, and was not flowing even during late May 1978.

(b) Alder Gulch

The very uppermost reaches of Alder Creek are ephemeral; however, the drainage soon becomes intermittent in three tributaries in the western edge of section 18, about two miles west of Zortman. These tributaries were flowing about 10 to 15 gallons per minute each day during an investigation in October 1978 by WESTECH Inc. and converged to form the main channel of Alder Gulch. This channel consits of bed material ranging in size from fine sand to boulders.

During the history of mining near Zortman, Alder Gulch has been the site of mining, milling, processing and placer operations, each altering the stream chann

service road runs from Zortman, across, beside and in the channel itself, to an abandoned mine which discharges small amounts of water. The typical flow from this mine, located near the center of section 18, is about five gallons per minute. Below this mine, Alder Gulch flows about 50 gallons per minute, which gradually disappears over a distance of about one mile. At the confluence of Pony Gulch and Alder Creek, both of these drainages are usually dry, flowing only during periods of high precipitation. In May 1978, Alder Gulch was flowing an estimated 10 cfs about one-half mile above Pony Gulch. Even though Pony Gulch is also normally dry at its confluence with Alder Gulch, there is a short, spring-fed, intermittent reach, flowing about 5 gallons per minute for 1,000 feet, about one-half mile above its mouth. Other than this segment, Pony Gulch is an ephemeral stream from divide to mouth. Below Pony Gulch, Alder Gulch remains an ephemeral stream, rarely discharging surface flows into Ruby Gulch at their confluence below Zortman.

(c) Lodgepole Creek (Glory Hole Creek)

Lodgepole Creek is the major drainage system of the northern slopes of the Little Rockies. King Creek which drains the Landusky mining area flows into Lodgepole Creek on its way to the Milk River. The northern face of the Zortman mining area is drained by another tributary, Glory Hole Creek, which is a steep and ephemeral drainage. Lodgepole Creek itself is intermittent and possibly perennial at its confluence with Glory Hole Creek. A significant amount of water is stored and released by numerous beaver dams above and below the confluence. A developed spring adjacent to Lodgepole Creek, and about 1,500 feet north of the proposed Zortman mining area, flows about 10 to 20 gallons per minute into Lodgepole Creek. The flow in Lodgepole Creek, below the spring and the dry mouth of Glory Hole Creek, was estimated at 50 gallons per minute in October 1978 by WESTECH Inc. Lodgepole Creek appears to be perennial at that point and increases in flow as it approaches the Fort Belknap Indian Reservation.

b. Surface water quality

Water quality is good to excellent in all the drainages associated with both mining areas, with the exception of about 3 miles of stream below the Gold Bug adit discharge. Waters are a calcium bicarbonate type and are hard to very hard, commonly having hardness values between 120 and 240 mg/l as $CaCO_3$. All drainages have relatively low total dissolved solids values, and quantity, not quality, appears to be the limiting factor for aquatic life, again with the exception of the Gold Bug adit discharge. All surface waters in the Little Rockies are classified B-D3; suitable for human consumption after adequate treatment including sedimentation and filtration to remove naturally occurring impurities. This classification requires that water quality in surface drainages must be maintained for human consumption and as a warm-water fishery.

As a part of the baseline assessment 15 sites were sampled for physical parameters, major ions, and/or metals by WESTECH Inc. Most sampling was accomplished during low flow conditions when mining and processing impacts would have the greatest affect on surface water quality. The water quality of most of the drainages near the Zortman and Landusky mining areas has been affected in some way by past mining operations. Most of the impact is due to erosion of old mill tailings, mine waste rock, and roads, although acid mine drainage is a problem on the Landusky side in Montana Gulch and a short segment of Rock Creek. In spite

of the continuing impact of past mining operations, the streams in the Little Rocky Mountains are of good to excellent quality, with the exception of the Gold Bug adit discharge, and are considerably lower in total dissolved solids than streams originating in the surrounding areas of Phillips and Blaine Counties. (Table II-3). The reduced quality of the Gold Bug adit discharge is caused by the influence of the sulfide ore body upon the water. The sulfide ore body is located beneath the oxide ore body proposed to be mined. A detailed discussion regarding the water quality of each stream in the area is continued in the hydrology report prepared by WESTECH Inc. and on file in the Department's Helena office.

c. Groundwater quantity

There is little groundwater information available in the Landusky-Zortman area. A summary of most of the wells and selected springs, near the proposed mining areas, is shown in Table II-4. Although no formal investigation has been done concerning groundwater in the Little Rockies, past mining operations have encountered water at various levels and times, providing a general theory about groundwater occurrence, movement and discharge in the upper elevations, including the mining areas themselves.

(1) Sources

The occurrence and distribution of groundwater is closely related to both local and regional geology. Groundwater resources are influenced mainly by several geological units, including a large aerial outcrop of porous porphyry, outcrops of Precambrian limestone, recent alluvial deposits, and a complex network of intruded dikes. Faults, joints and fractures allow an unknown amount of groundwater movement throughout the Little Rockies, and small quantities of water can usually be obtained from wells drilled into bedrock. Most of the recorded wells near Landusky and Zortman are located either in town or on ranches nearby, and are developed in alluvial deposits or shallow sandstones less than 200 feet deep. A number of alluvial springs provide small flows in many of the drainages and numerous springs are found around the entire base of the Little Rockies.

(2) Movement

Groundwater movement generally follows the slope of the land surface toward the stream bottoms. This is probably the case in the Little Rockies at the lower elevations around their base and in close proximity to the many stream channels. However, at higher elevations, where numerous mine adits and shafts have been driven into water-bearing zones and a great deal of fracturing exists, the general groundwater movement appears to be in the direction of the Gold Bug adit. This assumption is based upon a brief history of water as related to mining, explained by Ed Scholz (pers. comm., 1977) who periodically worked in the Zortman-Landusky areas. The history of groundwater movement in the area is discussed in detail in the hydrology report prepared by WESTECH Inc. and on file in the Department's Helena office. The water history of these properties suggests that the sub-surface water system is interconnected over a substantial area and probably is being drained by the Gold Bug tunnel.

The flow of the Gold Bug adit discharge is relatively constant, although now significantly lower than the 1,600 to 2,200 gallons per minute originally pumped from the Ruby winze. The flow varies slightly, around 500 gallons per minute, showing slight response to seasonal precipitation. When groundwater

Table II-3

Typical Water Quality From ZortmanLandusky

| STATION | Gold Bug Adit Discharge | Rock Creek @ Landusky | Rock Creek @ Kolczak | Intermediate Monitoring Well B | Deep Monitoring Well No. 1 | Barren Pond | Pregnant Pond | Lodgepole Creek Below Developed Spring |
|---|---|---|---|---|---|---|---|---|
| Location | 25N24E 22BDBB | 25N24E 27ABCA | 25N24E 34BCC | 25N24E 22CAAC | 25N24E 22CAAC | 25N24E 22CAAC | 25N24E 22CAA | 25N25E 6CCAB |
| Date | 8/19/77 | 5/24/78 | 5/24/78 | 8/8/78 | 8/8/78 | 8/9/78 | 8/9/78 | 10/12/78 |
| Time | | 1100 | 1130 | | | | | |
| Temp °C | | 8 | 9 | | | | | |
| Flow (cfs) | | 12.0 | 13.3 | - | - | - | - | 50 gpm |
| Lab Spec. Cond. (µmhos @ 25°C) | 490 | 147 | 395 | 480 | 560 | 7200 | 6200 | 360 |
| Field Spec. Cond. " " " " | | 112 | 285 | | | | | |
| Lab pH (standard units) | 6.7 | 8.1 | 8.0 | 7.8 | 7.6 | 11.2 | 10.6 | 7.5 |
| Field pH (standard units) | | | | | | | | |
| Calcium (mg/l as Ca) | 63 | | | | | | | 46 |
| Magnesium (mg/l as Mg) | 18 | | | | | | | 15 |
| Sodium (mg/l as Na) | 13 | | | | | 1620 | 1400 | 3 |
| Potassium (mg/l as K) | | | | | | | | 1 |
| Bicarbonate (mg/l as $HCO_3$) | 98 | | | | | 0 | 0 | 207 |
| Carbonate (mg/l as $CO_3$) | 0 | | | | | 3530 | 1760 | 0 |
| Chloride (mg/l as Cl) | 3.2 | | | | | | | 1 |
| Sulfate (mg/l as $SO_4$) | 153 | 33 | 53 | 2 | 15 | 2590 | 2790 | 12 |
| Alkalinity (mg/l as $CaCO_3$) | | | | | | | | 170 |
| Acidity (mg/l as $CaCO_3$) | 40 | | | | | | | 2.0 |
| Cyanide (mg/l as CN) | | | <0.002 | <0.005 | <0.005 | 270 | 99 | |
| Fluoride (mg/l as F) | 4.7 | | | | | | | |
| Arsenic (TR) (mg/l as As) | 0.19 | | | | | | | |
| Iron (TR) (mg/l as Fe) | 11. | | | | | 3.8 | 4.0 | |
| Copper (TR) (mg/l as Cu) | 0.05 | | | | | | | |
| Zinc (TR) (mg/l as Zn) | 0.88 | | | 0.10 | 0.11 | 63 | 20.8 | |
| Hydroxide (mg/l) | | | | | | | | |
| Turbidity JTU | | | | | | 833 | 200 | 0.31 |
| TSS (mg/l) | | | | 5390 | 5060 | 7 | 10 | <1 |
| Hardness (mg/l as $CaCO_3$) | | | | | | | | 178 |
| Analytical Lab | RC | RC | RC | RC | RC | RC | RC | RC |

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Table II-3. Continued

Typical Water Quality From Zortma[illegible]andusky

| STATION | Alder Gulch Mine Adit Discharge | Alder Gulch Above Adit Discharge | Ruby Gulch @ Headwaters (E. Fork) | King Creek Spring @ Tailings | Landusky Town Pump | Dick Kalal Water System |
|---|---|---|---|---|---|---|
| Location | 25N25E 18CAAC | 25N25E 18CAAC | 25N25E 7BDBCD | 25N24E 15DABB | 25N24E 27ABBD | 25N25E 18DA |
| Date | 10/12/78 | 10/12/78 | 10/13/78 | 10/13/78 | 10/13/78 | 10/13/78 |
| Time | | | | | | |
| Temp °C | | | | | | |
| Flow (cfs) | 5 gpm | 50 gpm | 30 gpm | 5 gp | | |
| Lab Spec. Cond. (µmhos @ 25°C) | 530 | 315 | 165 | 490 | 420 | 370 |
| Field Spec. Cond. " " " " | | | | | | |
| Lab pH (standard units) | 7.2 | 7.8 | 7.3 | 6.9 | 7.5 | 7.6 |
| Field pH (standard units) | | | | | | |
| Calcium (mg/l as Ca) | 77 | 44 | 21 | 70 | 58 | 50 |
| Magnesium (mg/l as Mg) | 12 | 7 | 5 | 14 | 13 | 10 |
| Sodium (mg/l as Na) | 16 | 10 | 7 | 8 | 9 | 10 |
| Potassium (mg/l as K) | 3 | 2 | 2 | 2 | 2 | 2 |
| Bicarbonate (mg/l as $HCO_3$) | 195 | 85 | 73 | 122 | 195 | 122 |
| Carbonate (mg/l as $CO_3$) | 0 | 0 | 0 | 0 | 0 | 0 |
| Chloride (mg/l as Cl) | 5 | 4 | 4 | 3 | 5 | 4 |
| Sulfate (mg/l as $SO_4$) | 100 | 74 | 16 | 134 | 45 | 70 |
| Alkalinity (mg/l as $CaCO_3$) | 160 | 70 | 60 | 100 | 160 | 100 |
| Acidity (mg/l as $CaCO_3$) | 15.0 | 3.5 | 4.0 | 20.5 | 8.5 | 4.5 |
| Cyanide (mg/l as CN) | | | | | | |
| Fluoride (mg/l as F) | | | | | | |
| Arsenic (TR) (mg/l as As) | 0.108 | | | <0.00 | 0.007 | 0.007 |
| Iron (TR) (mg/l as Fe) | 2.3 | | | 0.0 | 12.7 | 0.11 |
| Copper (TR) (mg/l as Cu) | <0.02 | | | <0.02 | 0.07 | <0.02 |
| Zinc (TR) (mg/l as Zn) | 0.08 | | | 0.05 | 0.82 | 0.03 |
| Hydroxide (mg/l) | | | | | | |
| Turbidity JTU | 8.7 | 3.5 | 3.5 | 0.45 | 31 | 0.83 |
| TSS (mg/l) | 5 | 1 | 3 | <1 | 82 | 1 |
| Hardness (mg/l as $CaCO_3$) | 240 | 139 | 72 | 231 | 197 | 168 |
| Analytical Lab | RC | RC | RC | RC | RC | RC |

RC: Resource Consultants
Billings, Montana

Table II-4 SUMMARY OF WELLS AND SPRINGS IN THE ZORTMAN-LANDUSKY AREA

Landusky area

| LOCATION | WATER SOURCE | DEPTH (FT) | DRILLED OR DEVELOPED | YIELD (GPM) |
|---|---|---|---|---|
| 25N24E27CAC | Well | 60 | 1958 | 16 |
| 25N24E27AB | Well | 110 | 1959 | 16 |
| 25N24E22CCC | Well | 44 | 1958 | 5 |
| 25N24E22DCCC | Well | 55 | 1958 | 15 |
| 25N24E27 | Well | 127 | 1967 | 6 |
| 25N24E27 (Lot #11) | Well | 159 | 1967 | 30 |
| 25N24E27 (Lot #11) | Well | 21 | 1967 | 5 |
| 25N24E28AA | Well | 215 | 1967 | 0.5 |
| 25N24E27A | Well | 55 | 1960 | 50 |
| 25N24E27(Lot 5,6,8) | Well | 200 | 1972 | |
| 25N24E27BADB (Lot 13) | Well | | | |
| 25N24E22BDBB | Gold Bug adit | 1700 (horizontal) | 1962 | 1000 |
| 25N24E23BC | Mill Gulch Spring | | Undeveloped | 5 |
| 25N24E15DBAA | King Creek Spring | | Undeveloped | 5 |
| 25N24E27CCCC | Spring | | | 40 |
| 25N24E34BBBB | Spring | | | 7 |

Zortman area

| | | | | |
|---|---|---|---|---|
| 25N25E17D(old Bill Kellerman Hotel) | Well | +38 | 1960 | 50 |
| 25N25E33AA | Spring | - | 1926 | 3 |
| 25N25E32BD | Spring | - | 1963 | 10 |
| 25N25E32AC | Well | 166 | 1966 | 15 |
| 25N25E25DD | Spring | - | 1963 | 3 |

| LOCATION | WATER SOURCE | DEPTH (FT) | DRILLED OR DEVELOPED | YIELD (GPM) |
|---|---|---|---|---|
| 25N25E17DAC | Spring | - | 1962 | 5 |
| 25N25E17CBB | Well | 12 | 1972 | 60 |
| 25N25E17DDB | Well | 60+ | 1962 | 10 |
| 25N25E17ACD | Well | | 1957 | 20 |
| 25N25E17BDD | Well | 36 | 1934 | 3 |
| 25N25E16 | Well | 108 | 1967 | 7 |
| 25N25E19ADB | Pony Gulch Spring | - | Undeveloped | 5 |
| 25N25E7DD | Ruby Gulch Spring | - | Undeveloped | 50 |
| 25N25E7DB | Spring, Ruby Gulch Headwaters | | Undeveloped | 30 |
| 25N25E7DC | Spring, Ruby Gul. Headwaters | | Undeveloped | 20 |
| 25N25E6CC | Spring | | Partially Developed | 10 |
| 25N25E18CAAC | Alder Creek Mine adit discharge | | | 5 |

was first encountered during mining, it appears that the larger flows were discharging accumulated as well as annually recharged waters. As the stored groundwater was depleted, the flows into the various mines gradually declined until a relatively steady flow was established, depending entirely on annual precipitation.

(3) Groundwater use

Domestic water supplies in Landusky and Zortman depend entirely upon groundwater, obtained either from wells or collection systems placed in alluvial materials. These water supplies are also used for livestock watering, small amounts of irrigation, and, in Zortman, for public consumption in a bar, cafe, and motel. Outlying ranches depend on a combination of springs and wells to supply water for domestic, livestock, and irrigation needs. Springs and the two adit discharges (Gold Bug and Alder Gulch) supply a relatively constant flow to sustain a base flow in a number of drainages. These flows are used by a variety of wildlife, including a significant beaver population. During past mining operations, groundwater was used for milling and cyanide processing of gold ores. Future mining operations propose to use groundwater for the heap leach process.

(4) Mining areas

There have been hundreds of core holes drilled in both proposed mining areas, varying several hundred feet in depth. These holes are often drilled into the sulfide ore zone which occurs beneath the ore that is planned to be mined, providing a delineation of the useful oxide ore body. Only rarely have any of these core holes encountered any water, except small amounts of trapped groundwater. The core holes usually terminate above the level drained by the Gold Bug adit (Frank Duval, pers. comm.). The lack of water encountered underlines the theory that the adit is effectively draining the upper elevations of the Landusky and Zortman mining areas.

(5) Processing areas

(a) Landusky

Ten monitoring wells were constructed in the fall of 1977, below the Landusky zinc precipitation plant ponds to detect any changes in groundwater level or quality and to provide early warning of process solution leakage, Seven of these wells were dug with a backhoe to bedrock, varying in depth from two to five feet below the ground surface. These wells have consistently been dry, with the exception of two wells that collected surface water runoff following a thunderstorm in May 1978. Two intermediate depth wells were drilled and cased to about 50 feet in bedrock, and were dry at the time of drilling. One of these wells, Intermediate Monitoring Well B, filled, having a water level of 38.2 feet below the casing top. However, Intermediate Monitoring Well A located only 50 feet away has remained dry since it was drilled. A deeper well, drilled and cased to 140 feet, encountered water at the time of drilling and had a static water level of approximately 90 feet. The level was measured again in May 1978 and read 83.2 feet below the casing top. All ten wells are capped to prevent accidental introduction of foreign substances, and the three deeper wells are locked to prevent vandalism.

(b) Zortman

There is very little information available on local groundwater conditions at

the Zortman processing site. The monitoring network is presently being developed, including wells to monitor shallow, intermediate and deep groundwater quality. Two wells have recently been drilled on Antonine Butte; one in the saddle where the leach pad is proposed, the other well on the east slope of Antoine Butte (25N25E7CBB). Both wells were drilled to a depth of 100'; neither encountered water (Frank Duval, pers. comm.). As locations are finalized for leach pad and pond placement, additional wells will be drilled and cased for monitoring purposes.

c. Groundwater quality

The quality of groundwater in the vicinity of each project includes the Gold Bug adit discharge, the Alder Gulch adit discharge, the Kalal water supply, Pony Gulch spring, King Creek spring, and the Zortman water supply overflow at the mouth of Right Hand Ruby Gulch, already discussed with respect to related surface water quality. The quality of two springs on the Kolczak Ranch, which contribute most of the flow to Rock Creek during extremely low flow conditions, is reflected by the water quality of Rock Creek during October 1977. Analyses of surface waters in Alder Gulch, Ruby Gulch, and Lodgepole Creek are actually indirect measurements of groundwater quality during the low flow conditions occurring during field examinations. In addition, the monitoring wells at the Landusky processing site and a developed spring north of the Zortman mining area have been sampled for direct measurements of groundwater quality. Ten groundwater sites were sampled by WESTECH Inc. in 1978.

The developed spring, located adjacent to Lodgepole Creek near the mouth of Glory Hole Creek is of excellent quality and very similar to Lodgepole Creek water quality. Analyses of groundwater taken from monitoring wells by WESTECH Inc. show that natural groundwater quality in the mining area is slightly better than Gold Bug discharge. Generally, natural groundwater has a pH above 7.4 and a conductivity ranging from 400 to 900 mhos. The concentrations of dissolved metals including copper, iron, and zinc appear to be substantially lower than in the adit discharge, due to the higher pH values in the groundwater intercepted by the wells.

B. The Biological Environment

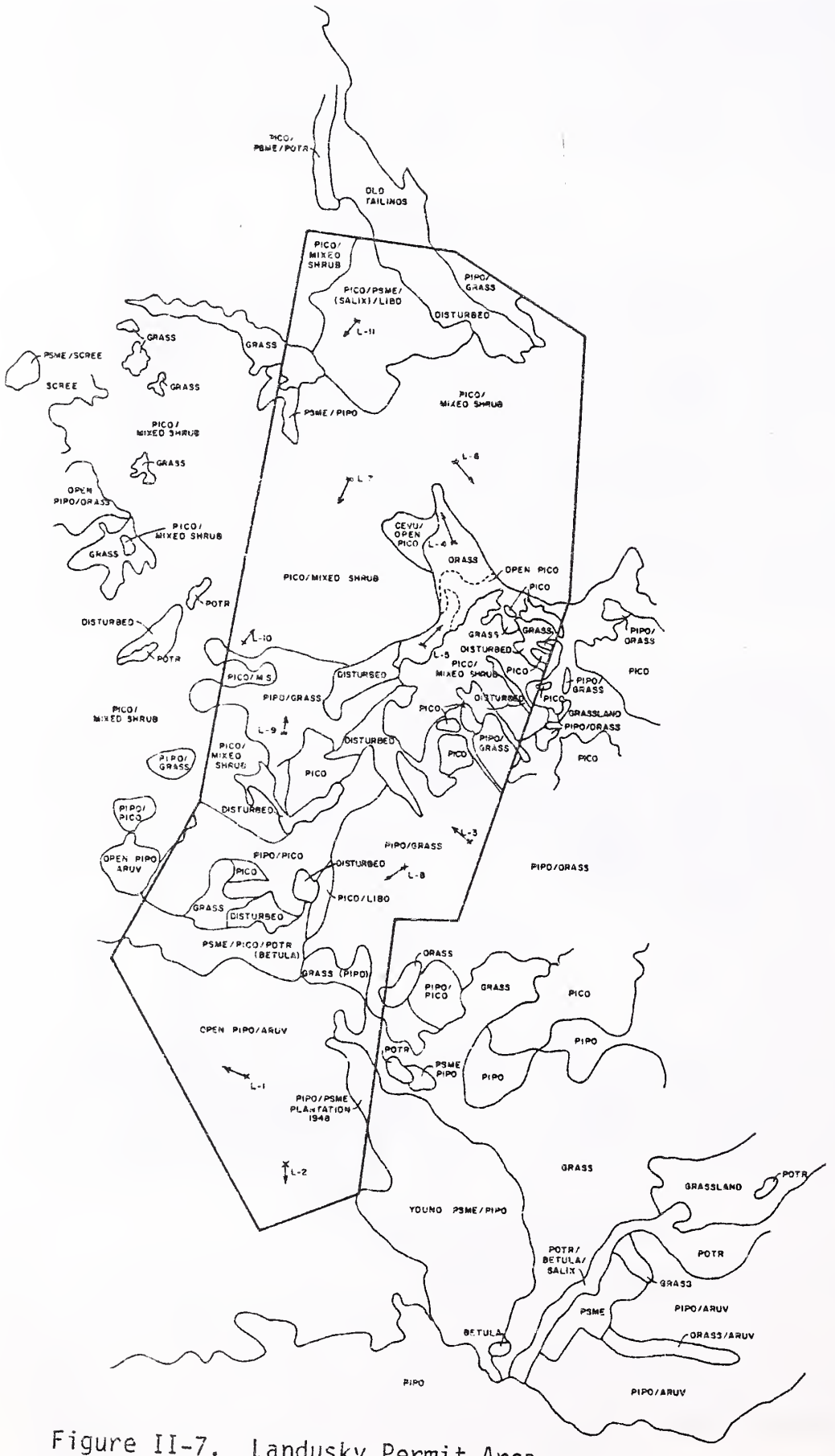
1. Vegetation

A seasonal study of the vegetation of the proposed Zortman and Landusky permit areas was conducted by WESTECH Inc. during the growing seasons of 1977 and 1978. Quantitative data was collected during the summer of 1978. Table II-5 lists the community types found on the permit areas and their status. Figures II-6 and II-7 present the location of those community types in the proposed permit are

a. Regional Vegetation Types

Floristically the Little Rocky Mountains are an isolated island separated by about 300 km (186 miles) from the main Rocky Mountain Range. Kuchler (1964), Morris (1964), Ross and Hunter (1976) and Payne (1973) have mapped the regional vegetation of the area. They have identified the Little Rockies as a coniferous forest ecosystem dominated by Douglas fir, Ponderosa pine and lodgepole pine. The mountains are surrounded by a mixed grass prairie dominated by needle-and-thread grass, wheatgrass, and blue grama.

Figure II-6. Zortman Permit Area
Vegetation Map.




LANDUSKY
VEGETATION COMMUNITY
TYPE MAP

Figure II-7. Landusky Permit Area Vegetation Map.

Table II-5. Vegetation Community Types of the Landusky and Zortman Areas

| Community type | Status | |
|---|---|---|
| | Landusky Area | Zortman Area |
| Grassland | minor | minor |
| Lodgepole pine/scree | absent | minor |
| Lodgepole pine/common juniper | absent | major |
| Lodgepole pine/mixed shrub | major | major |
| Lodgepole pine (Willow)/twinflower | minor | minor |
| Ponderosa pine/grass | major | absent |
| Ponderosa pine/kinnikinnick | major | minor |
| Ponderosa pine/snowberry | absent | minor |
| Quaking aspen | minor | minor |

b. Local community types

Recent investigations of the flora of the area (Culwell and Ramsden, 1978; Roberts and Sibbernsen, 1978) have identified several coniferous forest ecosystems dominated by lodgepole pine and Ponderosa pine with open grassland and quaking aspen minor types in the areas.

The majority of both proposed permit areas is dominated by lodgepole pine community types. These areas burned in 1936 and lodgepole, historically present in the Little Rockies, was quick to invade the burned sites. Douglas fir and Ponderosa pine are invading many of the lodgepole stands and without further disturbances, most of the area would support climax stands of fir and Ponderosa pine.

Ponderosa pine community types are present in the southern half of the Landusky permit area at lower elevations on drier aspects where the fires missed or did not kill the Ponderosa because of open overstory and light fuel loads. Ponderosa pine communities are not common in the Zortman area except in the vicinity of the proposed leach pad and facilities area.

2. Fish

The only known fisheries in the area of the proposed mining projects are located in Lodgepole Creek and Beaver Creek. A small school of six-inch trout was observed in a small pool of Lodgepole Creek by WESTECH Inc. personnel in 1978.

3. Terrestrial Fauna

Western Technology and Engineering Inc. (WESTECH) is conducting a four-season terrestrial wildlife survey of part of the Little Rockies, commissioned by the Zortman and Landusky Mining Companies. Three seasons (spring, summer and autumn) of study have been completed. A technical report covering these three seasons of study and containing detailed information on habitat, species lists and observations made during the study is on file in the Department's Helena office.

The terrestrial wildlife study area encompasses about 21,000 acres. Land ownership is either private (patented mine claims, town sites, and some ranch land)

or public (administered by the Bureau of Land Management). The study area includes foothills prairie, riparian bottoms, open Ponderosa pine forest, dense lodgepole pine forest, grassy meadows, scree, limestone or granite cliffs, past mining disturbances, and two town sites.

a. Herpetofauna

Very few reptiles or amphibians were noted in the Little Rockies study area. Farmer (1977) stated that he observed a racer (Coluber constrictor) in a Ponderosa pine/grass type near Montana Gulch, and a garter snake (Thamnophis spp.) in a deciduous streambank type in Alder Gulch. One leopard frog (Rana pipiens) was observed in Montana Creek at the mouth of the canyon.

b. Birds

During the first three seasons of study, 82 species of birds were recorded in the study area (Appendix C).

(1) Raptors

Cliffs and snags in the study area were examined for raptor nests in the spring, but no active nests were discovered. Some abandoned eyries were found in Montana and Alder Gulches. Many raptor nests were undoubtedly missed, due to the difficulty in locating eyries in dense forest.

Delap (1962) mentioned nesting peregrine falcons in the Little Rockies, and Farmer (1977) observed young great-horned owls and prairie falcons. Thompson (1978) did not specifically mention any breeding raptors for the Little Rocky Mountains. Ellis (1976) reported nesting merlins from nearby Valley County.

Although the principal investigator discovered no hard evidence (e.g. eggs or nestlings), circumstantial evidence (time of year, territorial defense) indicated that Cooper's hawks and American kestrels were breeding in the study area. Cooper's hawks frequented deciduous or mixed bottoms, while kestrels favored lowlands and foothills or open areas in the lower mountains. Red-tailed hawks were often seen soaring over forested areas of the mountains during the summer, and possibly nested within the study area. Golden eagles winter in the study area and probably hunt the proposed permit areas.

(2) Grouse and pheasant

Blue grouse were found to be quite common throughout the study area, never far from Ponderosa or lodgepole pine. They seemed to be most abundant on Gold Bug Butte, Antonine Butte, and in Grouse Gulch. Ring-necked pheasants and sharp-tailed grouse were present on the prairie bottoms and draws south of the Little Rockies, venturing into the study area in the lowest creek drainages.

(3) Merriams Turkey

Turkeys were introduced into the study area in the mid-1970's, and although the birds were not observed on the study area, Zortman residents reported occasional sightings during 1977. Most of these were from Bear Gulch, immediately to the east of Camp Creek, on the Fort Belknap Indian Reservation.

### (4) Other Birds

Other species of birds observed in the Little Rocky Mountains are listed in Appendix C.

## c. Mammals

To date, 19 species of mammals have been recorded (Appendix D). No rare or endangered mammals have been observed. Little is known of the bats in the area, but the nearest published record of the endangered spotted bat is Billings. Bobcats, a species of special interest due to its decline throughout much of its North American range, are uncommon in the Little Rocky Mountains. Red squirrels are characteristic of coniferous forests throughout Montana but are not present in the Little Rocky Mountains.

### (1) Rodent-like Mammals

A small mammal study conducted by WESTECH Inc. in the study area revealed the deer mouse to be by far the most abundant and widespread small mammal. A detailed discussion of the results of the study can be found in the wildlife report on file in the Department's Helena office.

Worthy of mention is the dwarf shrew (Sorex nanus), as recently as 1959 thought quite rare, and only very recently (1975) discovered as a glacial relict in the Sweetgrass Hills and Bear Paw Mountains (Thompson, 1977). This species may occur in the Little Rockies.

Woodrats (Neotoma cinerea) occur in association with mine adits, abandoned (and occupied) dwellings, and natural crevice shelters. Marmots (Marmota flavi ventris) occupy similar, more open areas. Porcupines are most abundant in lower Ponderosa pine types.

Pikas, meadow jumping mice, hoary bats, big brown bats, and little brown myotis may occur in some portions of the Little Rockies (BLM, 1972), but no positive evidence of these species was observed during this study.

Mountain cottontails were very abundant throughout the forested parts of the study area and seemed to prefer lodgepole pine, including the densest stands. Together with rodents, they probably constitute the staple diet of coyotes and the larger raptors in the Little Rockies.

Porcupines were found in the mountains or on the plains, especially near brushy thickets in bottoms. Much beaver activity was observed along Beaver Creek and to a lesser extent on Lodgepole Creek and Montana Creek, the latter apparently abandoned. Upper Montana Creek currently is polluted with water discharged from old mine adits and it is not known if these ponds were formed before or after pollution.

Yellow-bellied marmots were observed near abandoned buildings and rock piles associated with old mining activity on Ruby Gulch, Pony Gulch and Gold Bug Butte.

### (2) Carnivores

Coyotes were the most abundant carnivore in and near the Little Rocky Mountains. They were observed throughout the year in all vegetation community types. One badger was seen in Ruby Gulch near old mine disturbance, but a den was not discovered nearby.

No black bears or their evidence were observed during this study, however Farmer (1977) stated that two old scats, tentatively identified as black bear, were found in the Lodgepole Creek drainage at the north end of the Ruby mine reconnaissance area.

The BLM (1972) Unit Resource Analysis stated that black bear are not present and possibly never existed in the Little Rocky Mountains. However, the black bear's historical range covered most of North America (Hoffman and Pattie, 1968) and it seems unlikely that it would not have reached the Little Rocky Mountains. Weckworth (1971) indicated that the nearest occupied range is the Judith Mountains, about 50 miles southwest of the Little Rocky Mountains, and it may be possible that one or more individuals have wandered to the area.

### (3) Ungulates

#### (a) Elk

Elk were reintroduced into the Missouri Breaks in 1951 (Mackie, 1970). The population has flourished and there has been dispersal to the Little Rocky Mountains (Bureau of Land Management, 1972). The Bureau of Land Management (1972) reported that the Little Rocky Mountains contain some moderate-high value elk habitat, but that the overall value of the area is limited by its small size (both in respect to elk numbers and possible harassment). No elk were observed during the study period; however, area residents reported sightings in past years from Grouse Gulch, Alder Gulch and Ruby Gulch. Several residents speculated that elk move along C-K Creek from the Missouri Breaks to the mountains.

#### (b) Mule Deer

Mule deer are distributed throughout the mountains in summer, including the proposed mine permit areas. They apparently winter at lower elevations and on open south-facing slopes. The limits of the winter range in a particular year are probably determined by snow depth and browse availability. The proposed Zortman permit area is probably not winter range. The proposed Landusky permit area may be winter range during mild winters.

Mule deer were sighted more often than any other big game species in the study area. They were observed throughout the area, and tracks and pellet groups indicated that they used all habitats.

More mule deer were observed near the Zortman permit area than near the Landusky permit area. Farmer (1977) reported a similar result during his reconnaissance. The apparent difference in abundance was probably due to increased cover at the Zortman site. The Zortman site is primarily composed of lodgepole pine community types, while the Landusky site features more open types.

#### (c) White-tailed Deer

White-tailed deer are generally confined to riparian drainages year-round. They may occasionally occur in other habitats during spring, summer and autumn. Neither the proposed Zortman permit area nor the proposed Landusky permit area are considered white-tailed deer range during these three seasons. White-tailed deer winter habitat is dense riparian growth at lower elevations, with some foothills habitat probably used congruently. Neither proposed permit area is white-tailed deer winter range.

According to the Bureau of Land Management (1972), the Little Rocky Mountains have high value white-tailed deer habitat along major creek bottoms, including Camp Creek and Alder Gulch within the study area. High densities of white-tails were also reported from Lodgepole and Beaver Creeks.

Disease may be a limiting factor in the study area's white-tail populations. A map in Walcheck (1978) shows reported outbreaks of epizootic hemorrhagic disease (EHD) in the Missouri Breaks south of the study area, and to the east of the study area, in 1961 and 1976. While EHD was not reported from the Little Rocky Mountains, the proximity to outbreaks and the highly social nature of white-tailed deer suggest that it may be a causative agent in white-tail decline.

Sample size was too small to extrapolate population characteristics, or estimate population size.

### (d) Bighorn sheep

Very little data on bighorn sheep has been gathered since their introduction to the Little Rocky Mountains in the early 1970's. However, the population is apparently small and may be stressed by lack of desirable habitat, competition with deer, and human harassment. Gold Bug Butte, which includes part of the proposed Landusky permit area, was used by rams in summer during this study. Ruby Gulch, which includes the proposed Zortman permit area, was also used by rams in summer. However, these rams ranged over a much larger area than those on Gold Bug Butte, and none were seen within the proposed Zortman permit area. Ewe-lamb summer range was not determined.

Bighorn sheep are principally grazers. Gold Bug Butte and the proposed Landusky permit area have open habitat with grass, while the proposed Zortman permit area is mostly dense coniferous forest with little grass. Gold Bug Butte and part of the proposed Landusky permit area are therefore considered bighorn summer range. Although the proposed Zortman permit area lies within a large summer range, it is little used.

Bighorns apparently winter at lower elevations and on open south slopes in the southern half of the mountains. As with mule deer, winter range limits are probably determined by winter severity. The proposed Zortman permit area is probably not winter range. The proposed Landusky permit area may be winter range during a mild winter.

Geist (1971) indicated that while bighorns may have as few as two seasonal home ranges (summer and winter), rams may have as many as five and ewes as many as four. There were not enough sightings to define such ranges, but Gold Bug Butte and the Ruby Gulch drainages are summer ram ranges. Gold Bug Butte support-

ed two-four rams in summer.

The largest group observed was 24, and there was one known mortality, so that the early autumn population was at least 25. There were no definite sightings of lambs, and age classifications were tentative at best, so that successful reproduction could not be verified. Assuming that all sheep observed were adults, then over half of the potential 41 total sheep transplanted into the Little Rocky Mountains are still alive. Interview with area residents indicate that successful reproduction has probably occurred, but there have been too few sightings to document the stability of the population.

#### d. Endangered or Threatened Species

No rare and endangered bird species were observed during the first three seasons of study. There is a literature record from 1961 of nesting peregrine falcons in the Little Rocky Mountains, but the eyrie location was unreported. Prairie falcons, although no longer considered threatened, also nest in the Little Rockies but apparently not in the proposed permit areas. There is a literature record from 1976 of the merlin, a special-interest species, nesting in nearby Valley County. Since merlins nest in conifers, they may be present in the Little Rockies, but were never observed.

No rare or endangered mammals have been observed. Little is known of the bats in the area, but the nearest published record of the endangered spotted bat is Billings.

Bobcats, a species of special interest due to its decline throughout much of its North American range, are uncommon in the Little Rocky Mountains.

## C. The Social and Economic Environment

### 1. Introduction

At the request of the Department of State Lands, the consulting firm of John Short and Associates, Helena, Montana conducted a social and economic investigation and analysis of the proposed area of the mining operation and adjacent areas in Phillips County. The information used in this EIS to discuss the social and economic environment of the Zortman and Landusky areas is derived from that report.

### 2. Demography

#### a. Phillips County

The sites of the proposed mining projects are located in the Little Rocky Mountain Range in the extreme southwest corner of Phillips County. This "Hi-Line" region of Montana has experienced a prolonged period of population decline associated with fluctuations in the agriculture industry.

In the first three quarters of the 19th century the region was occupied by Indians, as it was included in the vast Blackfeet Hunting Territory. During this time the only white settlements were trading posts along the Missouri River. Then, in 1873, Congress reduced the Blackfeet Territory, opening more of the area to white settlement. Further white settlement did take place when, in 1884, gold was discovered in the Little Rockies. As many as 2,000 short-term residents came to the mountain range seeking gold and it was during this era that the gold mining towns of Zortman and Landusky came into existence.

Homesteading and dryland farming dominated Phillips County from 1900 to 1920. The first census was taken in 1920 and revealed a population of 9,311 in Phillips County - a figure which remains as the peak population to this day. From 1920 to 1970, as shown on Table II-6, the county experienced a 42 percent decline in population. The trend continued into the 1930's as a result of a severe drought and the Depression. In more recent decades the increasing use of farm machinery has served to reduce agricultural labor requirements even further. This pattern of population loss so closely related to agricultural trends has continued into the 1970's.

Malta, the county seat and largest city, has served as a focal point for many people migrating from the farms and ranches. During the 50 year period (1920-1970) Malta is the one area that has experienced generally steady growth.

Table II-6. Historic Population Trends Malta and Phillips County, Montana 1920-1970 (John Short & Associates, 1979).

| | 1920 | 1930 | 1940 | 1950 | 1960 | 1970 |
|---|---|---|---|---|---|---|
| Malta | 1,427 | 1,342 | 2,215 | 2,095 | 2,239 | 2,195 |
| Phillips | 9,311 | 8,208 | 7,892 | 6,334 | 6,027 | 5,386 |

b. Zortman and Landusky

The communities of Zortman and Landusky are separated by a mountain top. Unlike neighboring areas, their past economies have been based on mining rather than agriculture.

The "Gold Rush of 1884" brought the Little Rockies its first and greatest boom and bust period. Population gains and losses followed the cycles in mining employment and the net affect has been a steady loss of population. When the mines shut down permanently in 1951 the area's population began to show a steady decline, paralleling county-wide patterns.

c. Fort Belknap Reservation

The Fort Belknap Reservation was created in 1888 from remaining portions of the Blackfeet Hunting Territory. Most of the reservations' 1,200 square miles are located in Blaine County, but a narrow strip of reservation, running north-south, forms the western fringe of Phillips County. The initial boundaries of the reservation included all of the Little Rocky Mountain Range, but in 1895 reservation boundaries were redrawn to exclude mineral bearing lands.

In 1937 a census of the reservation was conducted which revealed a population of 1,487 (Montana Department of Community Affairs, Indian Affairs Bureau, 1978). In 1970 the U. S. Census found tribal enrollment on and within 50 miles of the reservation to be 1,571.

d. Recent Trends

As shown on Table II-7, from 1960 to 1970 the county continued to experience a

net population loss. In the current decade the county's population appears to have stabilized, but a continuing centralization of population in Malta is evident. A 1977 population estimate for Phillips County is 5,400 persons, rendering a population density of one person per square mile.

Table II-7. Recent Population Trends by Census Division Phillips County, Montana (John Short & Associates, 1979).

| Census Division | 1960 | 1970 | % Change 1960-1970 | Most Recent Estimate |
|---|---|---|---|---|
| Dodson | 511 | 327 | -36.0 | N/A |
| Landusky-Zortman | 174 | 162 | - 6.9 | 150 (1978)[2] |
| Loring | 212 | 180 | -15.1 | N/A |
| Malta | 3,453 | 3,310 | - 4.1 | N/A |
| Malta City | 2,239 | 2,195 | - 2.0 | 2500 (1978)[3] |
| Regina-Sun Prairie | 194 | 199 | + 2.6 | N/A |
| Saco | 750 | 562 | -25.1 | N/A |
| Warm Springs Creek | 234 | 222 | 5.1 | N/A |
| White water | 494 | 424 | -15.0 | N/A |
| Total | 6,027 | 5,386 | -10.6 | 5400 (1977)[4] |

[1] U.S. Department of Commerce, Census Bureau, Census of Population 1970 (tapes).
[2] Tuttle, Rick, 1978.
[3] Ulrich, Betty.
[4] Department of Community Affairs, Research and Information Systems, 1978.

Recent growth in Malta is attributable to employment in bentonite mining, the constructon of a bentonite processing plant, a major pipeline construction project and surprising growth in ancillary employment.

The population of the Zortman-Landusky area has continued to decline in the 1970's, with the area's population estimated to be 150 in 1978. Most of these people are residing in ranches situated beneath the mountain range in the small section of the Fort Belknap Reservation which is included in the Census Division. The population of the Zortman townsite, which was estimated to be 50 in 1960, is now 24. The population of the Landusky townsite has fallen to 14 (Kalal, Dick 1978) permanent residents. During summer months the towns are also inhabited by "summer home" residents and vacationers.

The population of the Fort Belknap Reservation increased by 157 between 1970 and 1977, a significant increase of 10 percent. The reservation also has been undergoing a slow shift of population to the Fort Belknap Agency Area.

It appears likely that Phillips County will reverse its historic pattern of population decline in the 1980's. This assumption is attributable to the increase in basic employment generated by bentonite development south of Malta. However, the trends of declining population related to agricultural employment are expected to

continue in most areas of the county, including the Zortman-Landusky area.

e. Racial Composition

The racial profile of the impact area reflects the presence of the Fort Belknap Reservation. Table II-8 compares the racial distribution of the impact area with State norms.

In 1960 Zortman was inhabited predominantly by Indians, but currently only two Indians live within the townsite (Kalal, Dick 1978).

Table II-8. Racial Characteristics Landusky-Zortman C.D., Phillips County, Blaine County and Montana 1970 (John Short & Associates, 1979).

| | White | Indian | Other |
|---|---|---|---|
| Landusky-Zortman C.D. | 114 (70.4%) | 48 (29.6%) | 0 (0.0%) |
| Phillips County | 5,115 (95.0%) | 258 ( 4.8%) | 12 (0.2%) |
| Blaine County | 5,143 (76.5%) | 1,562 (23.2%) | 22 (0.3%) |
| Montana | 663,043 (95.5%) | 27,130 (3.95) | 4,236 (0.6%) |

3. Local Economy

a. Regional Overviews

Located away from population centers, Montana's Hi-Line region has lacked the combinations of markets and resources necessary for manufacturing and industrial development. Isolated from heavily traveled transportation routes, the area has never developed the tourist trade which exists in some other areas of the state. As a result, the Hi-Line region has remained one the most agriculturally oriented regions in America.

Although agriculture remains the major industry in the region, its performance as an employment generator has been declining for decades. Most communities on the Hi-Line have been unable to attract new basic industries to compensate for job losses in the agricultural sector. Economic opportunities thus have been insufficient to support previous levels of population.

b. Phillips County

(1) Agricultural Base

With the exception of its experience with mining in the Little Rockies, the economic history of Phillips County mirrors the historic patterns of the region by relying almost totally on agriculture.

Generally, agricultural production in the county has been increasing, with the increases largely attributable to improved farming practices. However, increased productivity has not created additional farm jobs nor has it necessarily provided farm proprietors with greater incomes.

### (2) Other Basic Industries

No other economic activity in Phillips County approaches agriculture in importance. Only three percent of the county's labor force is employed in the mining or manufacturing sectors, which are traditional sources of basic employment. The government sector is the second greatest source of primary employment in the county.

The transportation and utilities sector was once a significant cource of basic jobs in the county, but employment in this sector has been decreasing. This reflects the national trend of reduced employment by railroads. The Bowdoin Gas Fields are located in the northeastern part of the county but are more signigicant as a generator of tax revenues than as a generator of local economic activity. The regional trade function of Malta is limited as Havre, Glasgow and Lewistown are larger communities and draw from the same market areas. The routes of U.S. Highways 2 and 191 do generate some tourist trade for county merchants, but not enough to make tourism a significant basic industry.

### (3) Recent Developments

Recent developments imply Phillips County will soon reverse its historic pattern of economic decline. Major pipeline construction projects are underway which will connect the Bowdoin Gas Field with out-of-state markets. Between 120 and 150 persons are being employed in summer months during this project. The pipeline construction has served to temporarily improve local economies and stabilize local populations.

More long-term economic stimulation is likely to result from development of the area's bentonite resource. American Colloid Company has obtained 620 acres of land south of Malta and intends to strip mine 250,000 tons of bentonite annually.

Bentonite development is expected to provide stable basic employment in the community for an extended period.

With the exception of the Zortman-Landusky mining project, there are no other major industrial developments being contemplated for Phillips County. A project which might have significant, but only short-term, effects on the local economy is the Northern Tier Pipeline. Phillips County is located on one of the pipeline's three alternative routes.

## c. Zortman-Landusky

The current economy of the Little Rockies area is oriented to agriculture and tourism. The rangeland which flanks the mountains, and the grassy woodland and pasture in the mountains themselves, are grazed by cattle. There are eight ranches which adjoin the southern perimeter of the mountain range. Most of these are large family run operations exceeding 30,000 acres in size. The rangeland in this area is generally of poorer quality than elsewhere in the county and cattle production per acre tends to be low. Labor requirements for ranches are seasonal with peak demand occurring during summer months.

In recent years Zortman has attempted to establish itself as a tourist center. The terrain and vegetation in the Little Rockies provide a pleasant contrast to

Montana's Hi-Line.

The two retail establishments in Zortman cater to tourists. The combination gas station, cabin rental and general store and the bar and restaurant report that business has been improving and they are optimistic about the future of tourism for the area (Tuttle, Rick and Dick Kalal, 1978). Plans are being made to expand the townsite's camper facilities and to improve its summer cabins.

Other businesses in Zortman include a small saw mill employing two men and a self employed building wholesaler. Also in the townsite is a seasonal BLM office and the office of the Zortman and Landusky Mining Companies.

The townsite of Landusky has no operating businesses.

d. Fort Belknap Reservation

The economy of the Fort Belknap Reservation is highly undeveloped. The construction of pre-cut homes represents the only substantial manufacturing enterprise in the reservation area. Tourism has not developed into a significant industry nor has a significant agricultural base developed. Government (the tribe, the Bureau of Indian Affairs, the Indian Health Service and other federal agencies), accounts for nearly half, of Fort Belknap's total employment. Most non-government employment is in agriculture and generally these jobs are seasonal (HEW, Indian Health Service, 1974). Employment in the service sector is extremely small relative to the size of the reservations population, implying that the tribe's service needs are met off the reservation.

The Fort Belknap Agency, located in the northern section of the reservation, serves as headquarters for governmental activity and hence is the focus of Indian employment. The Hays-Lodgepole area in the south and the areas of the reservation extending into Phillips County have virtually no stable economic base, and high unemployment.

e. Labor Force and Employment

Phillips County labor force patterns reflect both economic and demographic phenomena. Between 1960 and 1970 the size of Phillips County's labor force was reduced by 13.2 percent. In the 1970's the county's labor force has grown 20% and the labor participation rate has increased from 41% in 1970 to 49% in 1977 (see Table II-9). Since the county's population has not been paralleling this growth it is assumed that much of this additional labor force is seasonal or part-time. This implies a continued increase in female participation.

The labor force of the Fort Belknap Reservation represents an unusually small proportion of the reservations total population. In 1973 only 669 (34%) of the 1972 persons living on the reservation were in the labor force. Of persons in the labor force only 334 were employed, resulting in an unemployment rate of over 50 percent.

Table II-9. Labor Force Characteristics Phillips County, Montana, 1970-1978 (John Short & Associates, 1979).

| | Labor Force | Employed | Unemployed | Percent Unemployed |
|---|---|---|---|---|
| 1970 | 2195 | 2103 | 92 | 4.2 |
| 1971 | 2161 | 2066 | 95 | 4.4 |
| 1972 | 2212 | 2118 | 94 | 4.2 |
| 1973 | 2310 | 2196 | 114 | 4.9 |
| 1974 | 2431 | 2346 | 85 | 3.5 |
| 1975 | 2437 | 2324 | 113 | 4.6 |
| 1976 | 2580 | 2468 | 112 | 4.3 |
| 1977 | 2667 | 2523 | 144 | 5.4 |
| 1978[1] | 2626 | 2498 | 128 | 4.9 |

[1] October 1978

f. Employment by Industry

The distribution of Phillips County employment is much different than that of Montana as a whole, demonstrating the lack of diversification which exists within the county's economy, as well as its vulnerability to the trends and fluctuations of agriculture.

More recent Phillips County employment trends indicate that agricultural employment has stabilized while the number of farm proprietors has continued to decline slightly. Employment growth has been experienced in manufacturing, trades and services and all government sectors.

g. Income

In Phillips County, individual and aggregate incomes have been vulnerable to shifts in the profitability of agriculture.

Table II-10 traces recent trends in per capita income.

Table II-10. Per Capita Income - Phillips County, Montana 1967-1976 (John Short & Associates, 1979).

| | 1967 | 1968 | 1969 | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 | 1976 |
|---|---|---|---|---|---|---|---|---|---|---|
| Per Capita Income | 2834 | 2915 | 3236 | 3102 | 2659 | 3660 | 5361 | 4532 | 4524 | 4801 |

The 1970 census indicated that 15.3 percent of families and 15.8 percent of persons in the county had incomes of less than the poverty level. The 1970 census reported that 61.5 percent of the reservation's families and 68.1 percent of persons on the reservation had incomes below the poverty level.

4. Land Use

a. Introduction

Phillips County is Montana's third largest county, having a land area encompassing 5,287 square miles.

Events in the County's geologic history have profoundly influenced the nature of the county's development. The Little Rocky Mountain Range rises from the 2,000 foot plain of Montana's Hi-Line to an elevation of 6,000 feet. The last glacial period, which ended 40,000 years ago, left most of the county covered by a layer of glacial till - an unstratified layer of clay, silt and sand, and minor amounts of layer sediments. This top soil made agriculture possible in the county.

### (1) Phillips County

Agricultural land uses occupy 98 percent of the total land area of Phillips County. A short growing season, the lack of precipitation, shallow surface soils, and the presence of subsurface Bear Paw Shale and bentonite limit the potential for many types of agriculture in Phillips County. In most of the county growing conditions are best suited to native grasses, providing ample rangeland. The second most prevalent agricultural land use is dryland farming.

A very small proportion of the total land area in Phillips County is included in incorporated cities and towns, plotted townsites, and industrial land uses.

### (2) Zortman and Landusky Area

Non-agricultural land uses represent a very small fraction of the total land area and are primarily residential. Zortman townsite is located in a bowl area near the juncture of the Ruby and Alder Gulch drainages. The townsite is platted into many small irregularly shaped lots totalling approximately 80 acres. Most of this land is vacant, or occupied by structures which were abandoned in past "gold rush' periods. The townsite's 1/4 mile gravel surfaced main street is flanked by a general store-gas station, rental cabins, a bar-restaurant, a large butler building housing a wholesaler of such buildings, the mining companies office, and a seasonal BLM office. Interpersed are clusters of crumbling cabins and weathered commercial buildings. Residents are placed both north and south of the main street on looping roadways. At the base of the steep slopes which enclose the townsite are some recently constructed second homes. Four mobile homes are located on lots behind a section of abandoned buildings on main street. A few others are randomly placed in the townsite.

The large amount of vacant land on Zortman could seemingly accommodate a much larger population. A disincentive to land development in the townsite is the apparent inflation of land values.

An owner of several adjoining parcels within the townsite has expressed interest in developing a small mobile home park sometime in the future. However, most land outside of the Zortman townsite is unavailable for development. The BLM is reluctant to lease or sell additional land for residential uses. Irrespective of BLM policies, slopes and water access problems would in many instances make site preparation prohibitively expensive. The ranch association controlling foothill land south of Zortman is not interested in selling it for non-agricultural development (Dr. Vael Frank, 1978).

The townsite of Landusky is located along a gravel road connecting State Highway 66 with the August Mine Site. Landusky is much smaller than Zortman, including an area of less than 25 acres. Landusky consists of a mixture of abandoned buildings and older buildings which are still in use. The only non-residential land uses which have remained active are the Landusky Elementary School and the townsite post office.

There is a considerable amount of vacant land around the Landusky townsite. Most homes in the townsite are along its main street. Behind these homes is flat, seemingly developable, land. The Zortman and Landusky Mining Companies own five acres in the townsite and has expressed interest in developing the land for residential land use. In addition, a rancher owning land in the foothills south of Landusky has expressed interest in subdividing a large parcel of land. This particular land seems to have fewer physical constraints (water, drainage, etc.) to development than most other land in the area.

5. Land Ownership

a. Zortman-Landusky

The federal government controls a larger proportion of land in the Zortman-Landusky area than it does county-wide. Roughly one fifth of the 570 square mile area is included in the Russell Wildlife Range. The BLM controls most of the land in the Phillips County portion of the Little Rockies.

The Fort Belknap Reservation encompasses a township sized parcel on the eastern flank of the Little Rockies and at the head of the Beaver Creek Drainage. The State controls sections 16 and 36 of most townships in the area and a few intermittent parcels.

Sandwiched between the public and reservation lands are private holdings.

Private ranch lands constitute approximately a quarter of the total land area, forming a belt along the southern boundary of the mountains.

Private holdings in the townsites of Zortman and Landusky consist of numerous small parcels. Townsite land became deeded rather than leased land in 1969, when the BLM auctioned off lots after being petitioned to do so by area residents. The BLM limited the number of lots which could be purchased by a single family, thus insuring numerous ownerships. The Zortman and Landusky Mining Companies own 5 acres in Landusky.

6. Housing

In the Zortman-Landusky Enumeration Division of the 1970 Census, housing occupancy is described as follows:

Table II-11. Housing Occupancy - 1970 Census. (John Short & Associates, 1979).

| A<br>Owner Occupied | B<br>Renter Occupied | C<br>Vacant |
|---|---|---|
| 37 Units | 17 Units | 36 Units<br>0 For Sale<br>0 For Rent |

Column C is indicative of a previous era of housing and employment in the Zortman-Landusky vicinity. Due to a rather unique history based primarily on the boom and decline of mining, and due also to the lack of any major replacement in employment, the housing stock is a residual combination of rennovated dwellings and an almost equal number of abandoned structures. Although there do not appear to be any vacant conventional dwellings, some temporary housing could be available through the use of eight existing cabins at the Buckhorn tourist facilities in Zortman. Renovation of existing dilapidated structures would generally be uneconomical, judging by the preliminary windshield evaluation, and due to land prices.

In 1970 the median value for a house in the project area was $4,146 as compared to $11,205 in Phillips County as a whole (1970 Census). However, according to local realtors and planners, land and housing process have risen substantially since then and are now comparable to prices in the larger towns (Betty Ulrich, realtor). The rise in prices appears to be attributable to speculation, with land buyers being anticipatory of second home development and reopening of the mines.

While no new construction is evident in Landusky, some new construction of second homes and location of mobile homes is occurring in Zortman. Construction appears to be the result of increasing tourism in the Little Rockies, enjoyed primarily by residents of the region. This assumption was further substantiated by interviews with local residents.

Malta is presently experiencing a housing shortage. Vacancy rates are estimated to be around 2 percent and rental units are in great demand (Betty Ulrich). The situation is partially the result of the Kansas-Nebraska pipeline construction but is expected to be aggravated by the opening of a bentonite mining operation, expected to be underway in 1979. The housing shortage is compounded by the dirth of building contractors in Phillips County.

### 7. Transportation

Major highways in the impact area are U.S. Highway 2 and 191 and State Route 66. Highway 2 serves as the major east-west route through this region and is the area's most heavily travelled roadway. Most county roads are gravel surfaced roads designed to service sparsely populated areas and small scale economic activities. Local roads on the Fort Belknap Reservation are the maintenance responsibility of the reservation.

Rail service is provided to Phillips County by the East-West route of the Burlington Northern Railroad. AMTRAK provides passenger rail service to Malta. The area is also serviced by three bus lines. There are no regularly scheduled commercial flights into the county, although the Malta airport provides adequate service for small private planes.

#### a. Zortman-Landusky

Isolated and sparsely populated, the Zortman-Landusky area provides few of the goods, services and amenities which are commonly available in more populated areas. Residents of the area must travel great distances to obtain most goods

and services.

U.S. Highway 191 is the primary route connecting the Little Rockies with larger service areas. This highway is intersected by numerous gravel roads on its route between Malta and Lewistown, but traffic volumes on the roadway are low. Generally well maintained, the highway is subject to brief closures during storm periods (Phillips County Commission, 1975).

State Route 66 provides quick access to the Little Rockies from the reservation communities of Hays and Lodgepole. The characteristics of the roadway are similar to, but more winding than, U.S. 191. Route 66 is infrequently travelled.

Zortman and Landusky can only be reached by gravel surfaced roads. Zortman is accessible from U.S. 191 by two routes. The Bear Gulch road cuts through a portion of the Fort Belknap Reservation and provides the quickest access from Malta. However, Bear Gulch Road is often impassible in winter months. The 7-Mile Road is maintained by the county and is kept open except in instances of severe drifting. Landusky is connected to Route 66 by a 4 mile county road.

### 8. Government Services

#### a. Structure

Zortman and Landusky are unincorporated townsites. Phillips County, headed by a three member commission, is responsible for the provision of local government services to the area.

#### b. Revenue and Expenditure

##### (1) Tax Base

The taxable value of Phillips County in 1978 was $14,549,041. This ranked 36th among Montana's 56 counties. The mill levy administered by the county was 57.42 which is slightly above the median levy for counties.

The tax burden of the county falls heavily on its farmers and ranchers. Agricultural land, improvements, farm machinery, equipment and livestock constitute over 50 percent of the county's taxable value, compared to the State average of 20%.

Locally assessed utilities and public utility values allocated to the county by the State Department of Revenue account for nearly $2 million in taxable value, providing the county with 13 percent of its property tax revenue compared to 11 percent statewide.

Bentonite development in the county is expected to improve the tax base of the county. The construction of the processing plant will add a major capital facility to county tax roles. The bentonite mine will be added to the county's taxable value through the state's Gross Proceeds Tax formula. The pipelines currently being constructed in the county will also improve the county's tax base.

##### (2) Budget

In 1978 Phillips County property taxes provided $802,842 and other sources of revenue and carry over monies were expected to generate an additional $487,120.

Road related expenditures constitute the largest specific expenditure area for Phillips County. The road fund budget for 1978-1979 was $499,233.

9. Services

a. Introduction

The following discussions are limited only to key service areas. The discussions focus on how these services are provided in the Zortman-Landusky Area.

b. Law Enforcement

Law enforcement in the Zortman-Landusky area is provided by the Phillips County Sheriff's Department. The Sheriff's Department and county jail are located in Malta, 54 miles from Zortman and 61 miles from Landusky. Staff includes a sheriff and two deputies. The county's ratio of one deputy per 2,700 persons compares unfavorably with the state norm of a deputy per 1,000 persons (Camp, Mike, 1978).

The Sheriff's Department reports that it occassionally patrols in the Zortman and Landusky communities, but these visits are rare. Deputy response time from Malta is likely to be an hour, implying that the Zortman-Landusky area receives a low level of law enforcement service. Traditional crimes in rural Phillips County are related to trespassing and cattle rustling. In many instances these problems are handled locally without incident.

Since the initiation of the pilot mining project of the Zortman and Landusky Mining Companies, the sheriff has noticed an increase in crime in the Zortman area. He noted that several of the crimes were perpetrated against mining company property and were felonies (Camp, Mike, 1978).

Law enforcement on the Fort Belknap Reservation is provided by the tribal police. Deputies of Phillips County hold BIA cards which allow them certain law enforcement powers on the reservation. While a reciprocal arrangement for tribal police does not exist, there is cooperation between tribal and county law officials.

The sheriff's budget for 1978-1979 was increased by $25,000. A portion of this increase is earmarked for the hiring of an additional deputy. This will improve the departments deputy-to-population ratio, but the department will remain understaffed.

c. Fire Protection

The area's recent history is interspersed with major fires. In 1929 and 1944 the townsite of Zortman incurred major damage when fires swept down from the mountains. Twice in 1936 Landusky was threatened by flaming hillsides. On reservation lands, more recent fires have destroyed a significant portion of the tribe's

timber resource.

There is no organized fire protection in either Zortman or Landusky. The area's fire ratings are 10 which is the lowest possible rating. If a major fire were to occur in either townsite it is unlikely that equipment would arrive in time to prevent major losses.

To resolve this problem the county has recently provided Zortman with a used fire truck. The truck needs some maintenance but it will soon be usable. Area residents are in the process of creating a fire district which will cover a larger area than Zortman. It is unclear whether Landusky would join the district. The absence of sufficient water pressure in Zortman limits the potential for high-quality fire protection.

d. Water and Sewer

Water and sewer services are discussed jointly because of their integral characteristics.

(1) Zortman

In Zortman a shortage of potable water provides a potential problem for future townsite development. Current residents must overcome major obstacles in obtaining good water. The nature of the area's subsurface geology causes ground water to be unusable for domestic purposes. To obtain water, private individuals have extended water lines up Alder and Right hand Ruby Gulch. These water supplies are spring fed and vulnerable to variation in the annual amounts of spring run-off. In 1978 the townsite's water supply has been adequate, but previous drier winters have forced residents to ration their water (Kalal Dick, 1978). Deeper wells do not appear to be a viable solution to this problem, as they are likely to produce water of poor quality (Gartner, Ambrey, 1978).

Most sewage in the Zortman townsite is disposed of by individual septic tanks (some use of outhouses). A deep vein of gravel underlays most of the community, providing conditions compatible with septic tank use (Wirth and Associates, 1970). Because the community's water supply is acquired from drainages above the townsite there is little risk of sewage contaminating this supply.

(2) Landusky

Wells ranging from 50 feet to 200 feet produce an adequate supply of water at Landusky. This water contains high iron concentrations but is still potable. As in Zortman, Landusky is underlain by a large amount of gravel. Sewage is disposed of via cesspool and the systems function adequately at current densities (Wirth and Associates, 1970).

(3) Lowlands

The rolling lowlands which surround the Little Rockies create a different set of problems in water acquisition and sewage disposal. Groundwater in the area is highly mineralized, containing high amounts of magnesium sulfate and sodium (Gartner, Ambrey, 1978). The presence of Bear Paw Shale and Bentonite beneath the low-

land's thin topsoil serves to restrict the absorption qualities necessary for septic tank use. Only in foothill areas are conditions favorable for both well and septic tank use.

10. Education

a. Districts

There are three elementary schools serving the Zortman-Landusky area. In 1978 the Zortman Elementary School District was dissolved and the townsite was absorbed into Malta Elementary District. Malta provides daily bus service to Zortman; however, the two elementary aged children in Zortman attend the Robinson School, located eight miles away. The Zortman parents felt that a one hundred mile a day bus trip was too strenuous for very young children (Tuttle, Maves, 1978). The parents now pay tuition to the one room Robinson School which provides grades one through eight. The school also serves ranch families located southeast of the Little Rockies. In the Landusky area elementary aged children attend a one room school within the townsite. The Landusky School also provides grades one through eight.

The Malta High School District is the largest in Phillips County and encompasses the Zortman area and the lowland area served by Robinson school. The high school provides grades seven through twelve. High school aged children in Zortman ride the same bus that is available to elementary students. The high school district pays for this transportation and makes a payment for over-night student board in Malta. The district's budget for transportation and board for 1978 was $38,000.

The Landusky area is included in the Dodson High School District; however, Dodson is inaccessible from Landusky during winter months. Therefore, students from the Landusky area also attend the Malta High School. Since Landusky is not in the Malta District, the district does not provide bus service into the area. Landusky students must travel to Zortman for bus transportation.

b. Enrollments

None of the schools servicing the Zortman-Landusky area are overcrowded. Enrollments in the Landusky and Robinson schools are 6 and 9 respectively. Each school employs one teacher, creating an extremely low student teacher ratio . The limitations of these schools lie in their shortage of facilities and lack of versatility in staffing and programs. Recruitment of teachers is often a problem for small schools.

Enrollment in the Malta Elementary School is 307 (including special education students). This enrollment is smaller than the population the school was initially designed to serve, as the district has been losing enrollment. The school was built in 1952, added to in 1956 and in 1972 and is in good condition. The elementary school's most pressing need is for a library (Phillips County Planning Board, 1978).

Malta's high school was originally constructed in 1918 and added to in 1939, 1949, 1958 and 1972. Current enrollment at the school is 278 and the school's enrollment has been steadily declining, but not as rapidly as enrollments in the county's three other high school districts. The school averages 13 students per classroom and 10 students per teacher. Some problems associated with the high school are related to the obsolesence of the structure, lack of space, inadequacey of library facilities, poor science facilities, and a need for

better gymnasium facilities.

c. Finance

School taxes paid in the Zortman-Landusky area do not necessarily fund the schools which area children attend. Zortman townsite property taxes are paid to the Malta High School and Elementary Districts, but elementary aged school children attend the Robinson school. In Landusky, high school taxes go to Dodson, but students attend Malta.

School district levies in Phillips County tend to be lower than state norms. One reason for this is that even a low mill levy is likely to create severe hardship for a very large but economically marginal ranch. The Landusky and Robinson school districts rely heavily on state allocations of foundation fund monies to finance their programs. These districts also have very low operating budgets and this severely limits the nature of the services they provide.

11. Health and Social Services

Regional health and social services are provided primarily through agencies and facilities in Malta, some 65 miles to the north of the project area.

Two doctors presently serve Phillips County, staffing both the 30-bed Phillips County Hospital and a private practice in Malta. An on-call arrangement is provided through the hospital for a surgeon out of Great Falls.

Aside from ambulatory services provided from Malta and Saco, Zortman and Landusky are devoid of local health and social services. One World War II arms carrier is available to the communities for shuttling emergency illness or accident victims to the county ambulance. Addition discussions of health and social services can be found in the report prepared by John Short and Associates, 1979, and on file in the Department's Helena office.

12. Social Attitudes

The white population of the area is highly homogeneous. The area's stagnant economy has stimulated net out-migration for many decades but those persons who have remained have deep family roots in the area. Ranches are typically family operated and some ranches have been operated by the same family for several generations. In Zortman, businesses are also family run. Persons not involved in tourism are usually self-employed. Again, most residents of the Zortman townsite are long term residents of the area. Due to its small population, the Zortman-Landusky area lacks the formal institutions which develop in more populated areas. Residents tend to be self-relient and they expect little from government. When something needs doing the community appears willing to work together toward the common purpose. This is particularly true for ranchers, who must help each other during peak work periods as a matter of mutual survival.

Although no comprehensive attitudinal research was carried out in conjunction with this study, interviews were conduted with mining company officials, merchants in Zortman, public officials in Phillips County and officials of the Fort Belknap Reservation. Non-mining company residents of Zortman were neither supportive or in opposition to the proposed mining. Merchants implied they knew very little

about the proposed action, but acknowledged that if the mining activities did take place it would drastically change the nature of their businesses. The business operators felt the growth of mining would increase their sales and turn their operations into year-round rather than seasonal enterprises. At the same time, they expressed apprehension over the instability of the gold mining industry and the potential negative effects that a full scale mining operation might have on tourism in the area. These businesses have made no plans for physical expansion or hiring of additional help in anticipation of mining induced growth. If mining comes to the area they acknowledge that certain changes in their operations would be necessary. If mining does not occur, they seem quite willing to conduct their businesses as usual.

In Malta few people are informed as to the nature of the proposed mining in the Little Rockies. The project has received institutional support in the form of letters of endorsement from the Malta Chamber of Commerce, the Mayor of Malta (who is also president of the Chamber of Commerce) and the Superintendent of Malta Schools. There has been no organized opposition to the mining operation. Officials of the Fort Belknap Reservation were also uninformed regarding mining company plans. However, their reaction was strongly negative regarding the proposed project.

The absence of reclamation laws in Montana allowed earlier mining operations to despoil many areas in the Little Rockies. While the Zortman-Landusky operation is not responsible for past mining practices in the area, tribal members tend to lump mining companies in a negative stereotype.

Tribal members feel that racism is prevalent in the Zortman area. Some members harbor bitterness over a recent (1975) shooting incident in Zortman in which an Indian was killed by a white man, who was tried and aquitted in a non-Indian court. Interestingly, tribal members differentiated in their attitudes regarding the communities of Zortman and Landusky; having a more moderate perspective about Landusky.

### 13. Archeological and Historic Sites

On September 22 through September 27, 1978 an archeological and historical inventory and assessment project was conducted on the proposed mining permit areas by the Mineral Research Center, Butte, Montana. A detailed technical report containing the field methodology, results of the surveys, Site Inventory Forms, and management recommendations is on file in the Department's Helena office.

#### a. Prehistory of the Area

Gregg (1977) has shown how Mulloy's (1958) Early-Middle-Late Prehistoric Period sequence is a basis for subsequent refinement and absolute additions by colleagues in the filed of anthropology-archeology. The outcome, in the form of a chart, helps to give spatial and temporal consideration and perspective to Northwestern plains archeology (Table II-12). It should be noted that not all phases, complexes, and aggregates on the chart were found in the Missour Breaks survey area, from which this author is drawing much prehistoric information in regards to the Little Rocky region. Hell Gap materials have been reported to have been found near Harlem, Montana (Brekke, 1969). The Pelican Lake Keaster Site, and the Avonlea Timber Ridge Site have been found a few miles from the Little Rocky

area.

Table II-12. Provisional culture chronology for the Missouri Breaks, North-Western Plains Region (from Gregg 1977: Fig. 59).

| | Tradition | Period | Phase, Complex, or Aggregate | |
|---|---|---|---|---|
| AD | Plains Woodland | Historic | Blackfoot, Crow, Atsina, Assiniboin | |
| AD 1000 | | Late Prehistoric | Old Woman's | |
| AD 0 BC | | | Avonlea | |
| 1000 BC | Plains | | Pelican Lake<br>Hanna | Besant<br>Sandy Creek |
| 2000 BC | | Middle | | |
| 3000 BC | Archaic | | McKean | Oxbow |
| 4000 BC | | Prehistoric | | |
| 5000 BC | | | Pryor | Mummy Cave |
| 6000 BC | | | | |
| 7000 BC | Big | | Fredrick-Lusk-James<br>Cody-Alberta | Allen |
| 8000 BC | Game | Early | Agate Basin-Hell Gap | |
| 9000 BC | Hunting | Prehistoric | | |
| 10,000 BC | | | Folsom<br>Clovis | |

In regard to the natural and cultural environment of the Missouri Breaks survey area, Davis (1976) and Gregg (1977) have noted that prehistorically the primary economic base was hunting and gathering with sites representing these activities. Gregg has warned against broad statements in regard to the past environment's rapid change influence upon the peoples of the northwestern plains on a grand scale. Instead he notes that Bonnichsen and Bladwin (n.d.) have presented one the regions few anthropologically-oriented environmental presentations along with their study of "outlier" ecosystems and their relation to Indian prehistory and history. They used the ecosystem concept to divide the northwestern plains into a series of smaller units. One of these units is the mountainous outliers, which included the Little Rockies. Bonnichsen and Baldwin (n.d.:36-43) have documented that such outliers were logical places for Indian groups to winter because they supplied wood, water, food, horse pasturage, and shelter. During the warmer months they supplied edible plants, game,

pine poles for lodges, and relief from the hot plains summer. An entry of the Fort Benton Journal noted that there was a camp of Gros Ventres in the Little Rockies around May 25, 1856 (Bonnichsen and Baldwin n.d.:104). The outliers have been mentioned frequently in relation to Indian warfare and scouting. "Schultz (1962:325-327) has recorded an account by Aiko Pitsu, a Piegan, of scouting for enemies from the top of the Hairy Cap, a peak in the Little Rocky Mountains, and the presence there of an old war lodge." (Bonnichsen and Baldwin n.d. 43). The outliers were also exploited for religious purposes by the Indians.
The Little Rockies as a site for vision quests has been documented (Bonnichsen and Baldwin n.d.;49).

Gregg (1977) has further noted that survey of the Missouri Breaks area has suggested that the pine grassland ecozone may have been a favored locale for prehistoric site placement. According to Jochim (1976;63) hunters and gatherers commonly placed base camps near secure resources and widened their catchment by establishing satellite extraction camps near the more mobile, high prestige resources. Gregg has observed that the potential for these base camps to have existed in the Missouri Breaks area should be good, but if the food source potential for a large group was not plentiful enough, then the peripheral areas must be taken into greater consideration. Thus the "outliers", e.g., the Little Rockies, may have been the scene of large base camps, while the Missouri Breaks was an area of short-term, specific-resource exploitation. Present evidence from archeological surveys in the Missouri Breaks supports the latter statement.

The only archeological work done in the immediate Little Rocky Mountain area was conducted at Lookout Cave by Cecil Barnier (1969) and later at the same site by Burt Williams (report in progress). Lookout Cave is found within the Madison Limestone formation.

Heart Cave, a small sandstone rock shelter, was tested by Dale Frelund and Lynn Berry in 1969 but no cultural materials were recovered from the deposits.

b. Archeologic Survey Results

The cultural inventory conducted by the Mineral Research Center in September, 1978, determined that no prehistoric resources were evident on the surface in the proposed Zortman and Landusky Mining permit areas. There is a possibility that cultural remains may be unearthed during the mining process. However, the potential for the discovery of such deposits(s) is very low, since the slope of the hillsides is great, and aboriginal occupation of such steep slopes was usually intermittent at best.

c. Historical Occupation

Euro-American prospectors began surveying the Little Rockies during the Civil War, but economic conditions and the failure to discover paying gravel did not encourage mining until 1884. The next decade witnessed a placer mining stampede in which nearly two thousand miners participated.

Since the placer mines were located within the confines of the Fort Belnap Indian Reservation, Federal troops guaranteed Euro-American possession of the

mining areas. Boundary changes were imposed on the Natives in 1887 and 1895 and by the mid-1890's hard-rock mining supplanted placer activities. Pike Landusky and Pete Zortman organized the first mining companies with the capital capability to exploit the uncertain ore resources in the area. This period (1893-1923) was marked by a consolidation of holdings under the wings of one company, and a "boom" period of greater settled population and social services. A mill fire and a period of disastrous rainstorms closed mining operations during much of the 1920's.

A new exploratory venture reached a rich vein in the August mine which reopened in 1930 and a cut to the "glory hole" brought the Ruby mine back to productivity in 1935. World War II enforced production restrictions which closed the mines at the peak of 1942-45. After the war, mining resumed and continued until 1951. In 1957 the present owners acquired title to the land, but no mining activity had been recorded until the mid-seventies.

### d. Historical Survey

The following discussion contains a summary of the historical survey and results for the proposed Zortman and Landusky mining permit areas. Additional information including isolated finds and cultural materials and factors noted at each site are contained in the report prepared by the Mineral Research Center and on file in the Departments' Helena Offices.

#### (1) Landusky Permit Area

24PH 256 August Mine

N/W¼ of the N/E¼ of Section 15, T 25 North, R 48 East.

The August Mine is found relatively "scattered" over a gentle slope with a southwestern exposure and at the head of King Creek draw. Tailings from past mining activity fill the King Creek draw that extends below the mine to the northwest. The site appears to be laid out in several levels or "terraces", with old and new roads cutting parallel through the site, i.e., around the hill. The site appears to have been a thorough gold mining operation center. It consisted of an area where valuable ore was extracted from the ground; loaded into cars or containers and transported to a mill or to an area to be crushed; and where some of the smelting process for the chemical reactions necessary for acquiring pure gold went on.

According to Cory (1933;30) gold mining officially assumed importance in the Little Rockies when Robert Orman discovered the deposit that he staked out as the August claim in 1893. Subsequent claims around the August Mine were soon set up and worked, and what became termed the "August Group" by Cory eventually comprised twenty one patented claims, totaling approximately 365½ acres and three mill sites. Names such as Pike Landusky; Bob Orman: and Bogey have been associated with this mine. The August Mine is noted for yielding high-grade gold ore, and in an article in the 1931 Press-Bulletin 10618-B of the Department of Commerce, C.M. Gerry and T. H. Miller maintained that the August Mine was one of the largest gold ore producers in the state (Cory 1933:32, 34). Vandalism to the site itself is not readily evident. Disuse, implied abandonment and consequent

weathering, and lack of upkeep, have taken a toll on the site. Many structures have fallen down and decayed, leaving only foundations evident.

24PH 257 Little Ben Mine

S/E¼ of the S/E of Section 15 T 25 North, R 24 East.

The Little Ben Mine site is literally "set" up against the base of a steep hillside. The nearest water source is approximately 121.8 meters away, at the head of King Creek. The Little Ben Mine appears to have been a small operation for getting the (valuable) ore out of the ground and into carriers that transported the rock to a mill elsewhere.

According to Cory (1933:30), the Little Ben Mine was part of a separate group of claims that were worked near the August Mine. Perhaps the ore taken from this mine was transported to the August mill or farther south to the Gold Bug mill for final smelting. Costello (n.d.:5,6) has noted that after an hiatus in gold mining the Landusky district came back to life in the early 1930's.

> "Whitcomb organized the Little Ben Mining Company, consisting of six prominent men in the state--the Holter brothers and George McGee of Helena, John Corette and James Finlen of Butte, and himself. They acquired the August, found high grade ore in a new lead, built another mill and recovered still another fortune in gold."

Since there are so few features on this site it is difficult to tell if there has been any vandalism in the area. Abandonment and neglect are assumed to have had some influence as to the site's current condition.

24PH 254 Gold Bug Mine

N/W¼ of the N/E¼ of Section 22, T 25 North, R 24 East

The Gold Bug Mine, located on a southwest-facing hillside, extends across a draw to the east-southeast. The soil is rocky and thin; and an unnamed, perhaps intermittent stream* flows south-southwest through the site. The Gold Bug Mine appears to have been in an area used principally for separating the ore from the rock, although several adits which indicate local mining on the site were noted downhill and uphill from the mill.

Cory (1933;30) maintains that the Gold Bug Mine was first worked in 1894. The Gold Bug Mine consisted of four claims owned by the syndicate that managed the "August Group".

Vandalism was not obvious on the site, though the site has fallen into a state of disrepair.

(2) Zortman Permit Area

24PH 255 Ruby Gulch-Ruby Mine-Ruby Town Site

N/E¼ of the S/W½ of Section 7, T 25 North, Range 25 East, and N/W½ and S/W½ of the S/E½ of Section 7, T 25 North, R 25 East.



* Gold Bug adit flow

The Ruby Gulch area is a large site having an area of approximately 530,680.2 square meters. It presides at the head of Ruby Gulch with construction upon it having been done in a terraced manner, similar to the August Mine Site, with the terraces accessible by roads; and, in some cases, shored and supported by rock walls. The terrain is steep and at relatively high elevation in comparison to the Plains surrounding the Little Rockies. Tailings from several mills that have been constructed on the site fill Ruby Gulch entirely. In some portions at the northwestern head of the Gulch, the tailings have been overgrown by grasses, bushes, and deciduous and conifer trees; and form the base for the most recent structures that were constructed on the site. Historically, the site consists of: an abandoned townsite with eighteen buildings associated with the mining business; a smelter; surrounding mining adits, shafts, and holes; and a large mill that is off of the survey area.

According to Cory (1933:30), one of the first mines to be established in the Ruby Gulch area was the Alabama Mine in 1899. In 1904 the Ruby Mine opened. According to research done by Robert A. Murray for the Mineral Research Center, the Ruby Mine appears to have been at one time prior to 1904, the Ruby claim. The Ruby, Mint and Divide claims then became the Ruby Mine, owned by the newly organized Ruby Gulch Mining Company. The first Ruby Gulch mill was subsequently built, and during the years 1903-1912, a village, at first called Whitcomb, existed near the mill. For purposes of study, the aforementioned village is called the "Ruby Town Site", as it is the principal site in Ruby Gulch. Related mining adits, shafts, and holes may not be related specifically to the original Ruby mining claim, but to adjacent claims which became part of the Ruby Gulch Mining Company, and/or dependent upon er the Ruby Gulch mills for the processing of their ore.

There have been past and recent fires on the site. Vandalism such as broken windows has been prevalent in the past, and it appears that many buildings have been used, reused, and added onto through time. Theft of fixtures, furniture, etc., from the site area has taken place many times.

### 14. Recreation

Two Bureau of Land Management administered compgrounds are located in the vicinity of the proposed mining projects. The Montana Gulch Campground has 10 family units, and is located near Landusky, and the Camp Creek Campground has 15 family units and is located near Zortman. These sites are popular during the spring through autumn seasons and experience overflow problems during peak holiday use. Winter use for cross-country skiing is increasing.

General recreation opportunities include hiking, motor bike riding, hunting, cross-country skiing and pleasure driving or sightseeing between Zortman and Landusky. The area is experiencing increased problems with motor bike use on off established trails.

### 15. Visual Resources

The natural visual and esthetic resources of the Little Rocky Mountains have been heavily influenced by past mining activities. The large amount of road construction, exploration and mining disturbance, and tailing piles have reduced the visual resource of much of the area. The old townsites, mill sites and other remnents of the mining history of the area, however, may offer an aesthetic visual appeal to those persons who enjoy these features.

## III. ENVIRONMENTAL IMPACTS OF THE PROPOSALS

### A. The Physical Environment

#### 1. Topography

##### a. Mine Sites

Alteration of the existing topography would consist of the widening and terracing of the existing pits at the Zortman mine site, and the creation of a pit at the Landusky site. The creation of overburden and topsoil stockpiles at each site would add additional changes to the existing topography.

##### b. Leach Pad, Ponds and Structures

The proposed leach heaps, upon completion, would be 800'x800'x40', significantly altering the existing topography.

The leach solution ponds would not significantly affect the existing topography.

Structures at the leach sites are not significant in size and are located on nearly level ground. No significant impact to the existing topography is anticipated as a result of construction of the structures.

The existing road to the proposed Landusky mine and leach site would be reconstructed to a higher standard. The new road construction at the Zortman mine and leach site would be constructed to the same standards. This would result in cut banks and fill slopes higher and longer than presently exists, as well as an increased road surface width.

#### 2. Climate

The proposed operations would not result in an alteration of the existing climate.

#### 3. Air Quality

The expected impacts to air quality from the proposed operations include; generation of fugitive dust from pad, pond and plant construction, topsoil stripping and salvage operation, blasting during mining, dust generated during rotary drilling, and vehicle emissions. Vehicle emissions would include sulfur dioxide, nitrous oxides, and carbon monoxide. The leach pads may be sources of fugitive dust during the period when sprinkling does not occur.

Employees working at a heap-leach cyanidation installation may be exposed to cyanide in the form of dust and solutions, especially during mixing of concentrated stock cyanide solutions. Ingestion of as little as 0.20 gram of sodium cyanide is considered to be lethal for human beings. The heap-leach operation itself is considerably less hazardous because the leach is conducted in an open area with maximum ventilation. By maintaining the alkalinity of the leach solution at pH 10 to 11, the possibility of generating hydrogen cyanide

gas (HCN) is minimized, and only trace amounts of HCN can be released by interaction of NaCN and $CO_2$ in the enivronment. Measurements made by Mining Enforcement and Safety Administration (MESA) inspectors show that the HCN concentration in the air close to a working heap is consistently only 2 to 3 ppm. This is significantly less than the limit of 10 ppm established by OSHA for sustained breathing of gaseous cyanide (U.S. Bureau of Mines, 1978).

4. Geology

With the exception of the physical removal of portions of the ore deposits, resulting in a reduction of identified mineral resources, the proposed projects would have no direct impact upon the geology of the area.

5. Soils

The potential environmental impacts to the soils include (1) direct soil disturbance and soil compaction during such activities as mining, grading, leveling and construction, (2) soil erosion from areas during the above activities that have no or inadequate soil erosion prevention measures applied, (3) mass soil movement initiated by the above activities. It should be noted that the high content of coarse fragments that will be part of the stockpiled topsoil material should not impede revegetation. On reclaimed areas where slopes are less than 5 percent these fragments would provide stability to the surface layer and serve to retard erosion.

a. Mine site

The mine site at Landusky would incorporate 13.39 acres and at Zortman it would be 15.96 acres. The soils at the mine site would be completely disturbed. Salvage of suitable materials, stockpiling, replacement and revegetation would lessen the impact.

b. Leach pad and plant

The plant site at Landusky would be 2.2 acres and at Zortman the plant site would be 2.75 acres. Acreage figures for the leach areas are not known at this time. Development on these sites would result in permanent loss of some native soils. Stripping of suitable topsoiling materials and stockpiling and use for reclamation would lessen the longtime adverse impact. Suitable soil erosion control measures installed following land disturbance would also lessen adverse impacts related to soil loss and sedimentation.

c. Mine roads

Roads at Landusky would utilize approximately 8.2 acres and at Zortman 4.23 acres. The impact to soils resulting from the mine access road would primarily involve a redistribution and mixing of existing soils caused by higher and longer cut and fill slopes involved in the upgrading of the existing road. This would increase the potential for erosion and sediment transport until revegetation occurs. The improvement or installation of erosion control measures and structures on the present road system during road upgrading would reduce the present erosion hazards along these roads.

d. Utility lines

Construction and maintenance of utility lines would result in a redistribution and mixing of existing soils. Erosion would be the most serious problem which may be caused by equipment during site preparation and installation. Potential soil erosion increases when these activities occur on steep slopes, particularly so where the activity is up and down slopes rather than on the contour. Potential soil mass movement and landslide erosion are related primarily to these land disturbing activities on steep mountain slopes. Removal of plant cover during these activities also increases the potential for soil erosion. Erosion control measures would be implemented during this activity.

6. Water Resources

a. Mining Operation and Road Construction

Both proposed mine pits and any new roads constructed or upgraded for the projects would remove topsoil and create potentially erosive areas. In addition there may be spills of petroleum products and antifreeze in the areas of the mine and associated disturbances. Both mine areas, however, are located very close to drainage divides and are not expected to intercept substantial amounts of runoff from undisturbed areas above the pits.

Plans to collect all runoff from disturbed areas in holding ponds will reduce or eliminate the contribution of these areas to direct surface runoff. Only runoff events in excess of the holding pond capacity (10-year-24-hour storm) will flow on to existing streams. Impounded water will be lost by evaporation or infiltrate to the subsurface water system. An estimate of how much runoff will exceed the pond capacity is difficult to make. In average (precipitation) years probably little or none of the runoff will pass through the pond's spillway system. As a result, all precipitation on disturbed areas will be disposed to evaporation or percolated into the ground.

The sediment contribution from roads will be minimized by use of ditches and drains to prevent overland flow eroding soil material, and to channel drainage from undisturbed lands away from the road. Reclamation, retopsoiling and revegetating road surfaces at completion of the mining project will provide future erosion control.

Some precipitation or surface water trapped in proposed open pits may infiltrate and contribute to the groundwater system; precipitation that would ordinarily be surface flows. Although there is no detailed technical information describing goundwater movement in the proposed mining areas, it is assumed that most of the water trapped in the pit will seep into the fractured bedrock and become part of the regional groundwater system of the upper Little Rockies. The amount of water trapped would be insignificant compared to the regional groundwater system and any impacts to groundwater quality probably would be undetectable. The infiltration of surface water to the groundwater system would be very localized and should not cause any measurable change in groundwater quality.

The proposed mine pits would not mine into the sulfide ore body, but rather the oxide ore body which is not conducive to the formation of acid mine drainage.

Acid drainage is therefore not considered a potential threat from the proposed projects. Should expansion of the project involve use of the sulfide ore body, acceptable precautions necessary to guard against acid drainage would have to be developed.

Lime is proposed to be added to the ore at the mine site for transport to the leach site. Should an ore truck overturn or lose its load while traveling to the leach site lime could find its way into the area's ephemeral surface water flow through overland flow during snowmelt or heavy precipitation events. Since the ore haul route is located in the upper most portions of ephemeral drainages, is is anticipated that any spill would be cleaned up before it had a chance to reach flowing surface waters. In addition, there would be an economic incentive to the mining company to promptly recover any spilled ore, thereby further reducing the threat for adverse affects caused by ore spills.

b. Leach Pad and Processing Sites

(1) Surface Water

Two major concerns regarding the maintenance of the existing surface water quality can be identified: sedimentation and chemical contamination.

Construction activities at the facility sites will increase the potential for erosive action and resultant sediment generation. The mining companies have proposed to construct berms around all disturbed areas at the facility sites that would direct all overland surface flow in these areas to the process pond system. This would eliminate the potential for the addition of significant sediment to the area's ephemeral drainages as a result of the construction and operation of the facilities. The areas drainages may experience increased sedimentation during the construction of the facilities.

The proposed facilities are located in areas that are not considered to be conducive to the accumulation of heavy snow amounts. Excessive snowmelt, therefore is not anticipated to pose a problem as regards the storage capacity of the process ponds during normal operations or winter shut-down of the leaching operations.

At the Landusky facility site an emergency storage pond has been constructed which will be capable of storing any overflow from the process ponds in the event of an emergency, or in case of pond liner failure. This emergency pond is located above the Gold Bug adit and will hold slightly over a million gallons (three (3) acre feet) of solution storage. The pond will be lined with 36 mil. hypalon liner, reinforced on 5 by 5 centers, and covered with sand. The rectangular pond will be enclosed by a six (6) foot hog wire fence to control access. The solution would be pumped to the storage pond back through the existing water line which runs from the Gold Bug adit to the process plant. This line will be controlled by a T valve. A similar emergency storage pond is not proposed for the Zortman facility site at this time.

In order to understand the potential and causes of the risk for chemical contamination of the area's water resources as a result of the proposed project, a review of the leaching process is helpful.

At the start of a leach operation the system is in a transient state with respect to pH, water volume, and cyanide and zinc concentrations. These four factors eventually reach a fairly steady state point even though water, lime, cyanide and zinc are periodically being added to the system. In order for this to happen the system constantly removes these substances in a number of ways. The most obvious is loss of water by evaporation during sprinkling and from the ponds. Some cyanide also is lost while exposed to sunlight and oxidation in the ponds and while being applied to the leach heap. The remainder of the cyanide loss is due to the formation of insoluble salts within the heap (Peele, 1941). Natural oxidation of sulfides in the heap tends to produce acidic molecules which are neutralized by the lime. The acid formation is fairly slow during the actual leaching operation and only small amounts are added during that time. The remaining factor is the addition and loss of zinc during leaching. In the precipitation process, zinc is added to the pregnant solution and causes gold and silver to precipitate while the zinc complexes with the cyanide and remains in solution. The soluble zinc then flows with the solution to the barren pond where two things happen. At the high pH of the ponds, some zinc precipitates out as a calcium zincate, $Na_2Zn(CN)_4 + 2Ca(OH)_2 = CaZnO_2 + Ca(CN)_2 + 2NACN + 2H_2O$. The remainder of the zinc stays in solution and is cycled to the top of the heap. As the solution percolates through the heap some of the zinc, in the zinc-cyanide complex, can combine with soluble sulfides in the ore to form insoluble zinc sulfides, $Na_2S + Na_2Zn(CN)_4 = ZnS + 4NaCN$ or the insoluble calcium zincate (Hamilton, 1920). Both reactions precipitate zinc, which is filtered out by the heap, and regenerate free cyanide which is then available for dissolving gold and silver.

The pregnant pond receives runoff from the leach heap. This runoff may contain undissolved lime particles, suspended sediments, metal hydroxide sludges, and possibly precipitated gypsum. The pond may also receive runoff from disturbed lands peripheral to the pond. The barren pond receives effluent from the zinc filter presses and may contain some metal hydroxide sludges and some suspended sediment, including sediment from runoff from disturbed areas peripheral to the pond. Quality of water in these ponds depends on the length of time the pond has been operated, the type of ore that is being leached and the water used in the leaching process. The ponds typically will have high concentrations of calcium, sodium, sulfate, and cyanide, will be very high in alkalinity, have a high pH, and contain some metals, particularly zinc, and iron and metallocyanide complexes.

Sludge will collect in the barren and pregnant ponds, and will be composed of sediments and precipitated salts from the leaching solution. Typically these sludges will be high pH, have high alkalinity, and contain concentrations of metallocyanide complexes, and metals, especially zinc. The sludges can be periodically or continuously removed from the ponds by pumping them to the top of the heap with the process solution.

If several major precipitation events were to occur immediately one after the other, it is possible that the leach heap and surrounding area could provide more effluent than either the pregnant, barren, or emergency pond could hold. In that event, the ponds could overflow or sustain a structural failure of some kind. If this event were to occur, or the ponds experience a structural failure during normal operations, a large volume of water, containing an unknown amount of potentially toxic materials, would enter the ephemeral drainage nearest the ponds. In addition to the potentially toxic liquid, an unknown quantity of pond sludge,

possibly from both the pregnant and barren ponds, would enter the surface drainage system.

Of major concern should a spill occur or the ponds discharge to surface drainage systems would be the cyanide and metallocyanide complexes contained in the solution. Cyanide, to remain as cyanide in the solution, requires a pH of 10 or greater. Below a pH level of 10 the cyanide is converted to cyanate, considered to be about 1/1000th as toxic as cyanide. Peter Doudoroff (1976) in his EPA report titled "Toxicity to Fish of Cyanides and Related Compounds" concludes the following regarding the toxicity of cyanate:

> *The cyanate, CNO, ion, which is a product of oxidation of cyanide by alkaline chlorination, a widely used method of wastewater treatment for cyanide removal, also appears to be relatively but not entirely harmless to fish. . . Enough information about the (past) experiments performed and the results on which thse values are based has not been included by the authors, however, in the cited publications. Cyanates may persist in water for a long time but are subject to hydrolysis yielding ammonium and carbonate ions.*

In the event of a process pond discharge, it is doubtful that the solution would remain above a pH of 10 for a significant distance beyond the discharge. When cyanide is converted to cyanate, some free cyanide gas (HCN) is released. This reaction would not be considered hazardous, however, because the proposed facility site would be located in an open area with maximum ventilation.

If the discharge of process waters were recognized by employees of the proposed leaching operation as being eminent, the addition of calcium hypochlorite, a strong oxidizing agent, to the process water would effectively destroy the cyanide in the solution. Calcium hypochlorite, or other appropriate oxidizing agents will be stored in areas of possible spills and all workers at the proposed facilities will be instructed as to their proper use.

Of perhaps greater concern than the cyanide in the solution of any spill or discharge of process water from the facility site is the occurrence of the metallocyanide complexes in the waters. These components of the process water solution, once thought to be relatively stable, and harmless as a result, have recently undergone further research that has indicated otherwise. Doudoroff (1976) states that "results of experiments on the toxicity of the complex cyanides have been often misinterpreted in published literature, largely because of insufficient understanding of the complicated chemistry of dilute solutions of these compounds." He further concludes that "unfortunately, most of the pertinent literature has to do with lethal effects and tolerance limits, and the available information on sublethal effects of cyanides is scanty. Knowledge of the tolerance limits alone obviously is not a sufficient basis for any definite conclusions as to limits of entirely harmless concentrations of toxicants."

Many earlier researches of cyanide complex toxicity failed to consider adequately, the large differences in stability of the different complexes and the important influence of pH on the dissociation of the complexes in dilute

solutions. Doudoroff (1976) states that "the degree of dissociation and toxicity of a metallocyanide complex can vary greatly with the pH of the water." Doudoroff (1956), experminenting with fathead minnows, Pimephales promelas, found the toxicity of the zinc-cyanide and cadmium-cyanide complexes to be very great. He concluded that this high toxicity was ascribable mostly to liberation of virtually all of the cyanide (i.e., nearly total dissociation of the complexes) in very dilute solutions. Complexation of cyanide with nickel, copper, and iron greatly reduced its toxicity, but the toxicity of the nickelocyanide complex was found to vary strikingly with the pH of the solutions and to be quite pronounced (not very much less than that of NaCN) at pH levels as low as 6.5-6.6. The findings of Doudoroff, Leduc, and Schneider (1966) did not show the toxicity of the metallocyanide complex ions themselves to be always slight, or the contribution of these ions and the more toxic heavy metal cations deriving from their dissociation to the toxicity of solutions of complex cyanides to be always neligible. The experimental results, however, did lend strong support to the supposition that the acute toxicity of fish of very dilute solutions of complexes often to be found in industrial waste waters is usually due predominantly to the presence of free cyanide liberated by dissociation or decomposition of the complexes in the form of accurately measurable, molecular HCN.

The relation of pH levels to the dissociation and toxicity of the metallocyanide complexes to fish and other aquatic life is very important. The influence of snowmelt in the area of the proposed leaching facilities could be reasonably expected to seasonally lower the pH levels of the ephemeral surface waters to 6.5 or lower . Should a spill of the process waters containing the metallocyanide complexes occur at such a time, there would be a increased potential for an adverse toxic impact to any aquatic life found in the waters receiving the spill or discharge. It must be remembered, however, that free cyanide in water converts to the much less harmful cyanate within a short distance of its introduction. The lack of any perennial surface waters in close proximity of the proposed leaching facilities, and the further lack of any substantial fisheries in these waters, make the potential for a significant toxic event to the areas surface water systems slight. Additionally, it is known that cyanide will break down to cyanate in the presence of ultraviolet radiation, such as received in sunlight at the proposed facility sites.

### (2) Groundwater

Because of the utilization of both membrane and clay liners it is not anticipated that either operation will have a significant affect on groundwater quality or quantity during normal operations. A lining failure could occur, however, in either the heap or process water pads releasing an unknown amount of solution to the groundwater of the area. This solution could typically have a high pH, with high total suspended solids and possible high metal content. It is doubtful that the pH of the solution, however, would remain at high enough levels required to maintain the presence of cyanide during its seepage to the groundwater. The presence of significant amounts of heavy metal ions in the seepage would be of a potentially greater concern. The groundwater system of the area is complex and not fully understood. The ultimate destination and potential threat of solution seepage from the proposed facilities is therefore unknown.

Groundwater in the alluvium of Alder Gulch provides domestic water for some residents of Zortman. Residents of Landusky receive their water through wells drilled into the groundwater of the area. Because of the uncertain nature of the potential threat to these water supplies and the fact that lost process water means lost gold and silver, the mining companies have proposed the groundwater monitoring system discussed in chapter one to protect the area's groundwater systems.

At both projects groundwater will be utilized for process water and make-up water in the leaching system. Potable water will be used by mine personnel and their families for domestic and sanitary purposes. Based upon field investigation and information supplied by the mining company, it is anticipated that 120 ac.ft./yr. of groundwater will be utilized in each project's pond system. This water will be drawn from the groundwater supply of the region and will be a resource removed from other potential uses. It is estimated that approximately one acre-foot will be used to bring each pond system up to its operational level annually. This water will have a consumptive loss due to evaporation and will periodically be brought back to its operational level by addition of more groundwater. No feasibility study has been conducted to determine if adequate groundwater exists for use by both the proposed operations and the residents of Zortman and Landusky.

c. Reclamation

All slopes disturbed during mining will be returned to approximate original contours, or the equivalent, when possible. No backfilling of the pit is anticipated. When the project is complete, final pit walls will be benched, and the pit floors will be sloped and graded in such a manner as to prevent the accumulation of stagnant water. Reclamation of the mined area, if successful, would not result in any adverse impact to the area's water resources.

When the leaching operation is complete, the leach pads will be rinsed with water. By rinsing with fresh water a number of times, the pH of the heap will be reduced, thus allowing a conversion of cyanide to cyanate. The heap surface provides a substantial evaporation source which will reduce the amount of water present in the system. In the process of evaporation the heap will function as a filter, reducing the reagents, zinc, metallocyanide complexes, and other elements contained in the process water. Sloping of the heap to discourage infiltration of precipitation should reduce the potential for active seepage from the heap after abandonment.

The U. S. Bureau of Mines (1978) states the following regarding the results of heap washing:

> *It is clearly advantageous from an economic standpoint for the mine operator to lower the soluble gold losses in the heap to a minimum by thorough washing of the leached ore with fresh water. The washing step results in recovery of most of the dissolved gold and a large portion of other cyanides remaining in the heap as free cyanide or complexed with heavy metals. Heavy-metal cyanide salts are known to persist for several years, but residual free cyanide in abandoned heaps is believed to exist no more than 1 month, depending on climatic conditions; however, scientific data to support this contention are lacking. The*

*retention and fate of residual cyanide in heap leached residues is being scrutinized to an increasing extent by regulatory agencies.*

When the heap rinsing process is completed, rinse water remaining in the ponds will be allowed to evaporate. This may result in the deposition of an unknown amount of residue in the pond bottom. Typically these residues have a high pH, high alkalinity, and contain metallocyanide complexes and other metals, especially zinc.

Once the water has evaporated from the ponds, the mining companies propose to break the hypalon membrane and breach the dam on the downhill slope of the ponds. The hypalon membrane and residues in the bottom of the pond will be buried during the grading procedure. The retaining dam on the downhill side of the pond, the side and pond floor, will be graded to the approximate original contour of the site. When grading is complete, the area will be spread with available topsoil and revegetated.

The proposed burying of the pond residue will increase the potential for the entrance of the residue's components into the groundwater system of the area. The toxicity of these components is discussed in the previous surface water impact section. Successful reclamation of the pad and pond sites will reduce the potential for overland flow to the area's ephemeral drainages following their abandonment. The restoration of original drainage patterns during reclamation will prevent the accumulation of any snowmelt or rainfall in the area of the reclaimed surface, thereby eliminating the threat of impoundment failure at some time after completion of the project.

d. Cumulative impacts

There are two theories regarding the cumulative impact of two open pits to the groundwater system in the Little Rockies. One theory postulates that the groundwater regime between the two mines is separate, there is no contiguous groundwater body between the two areas. The second theory is that the two areas are probably connected by a fractured and complex geologic system which is reflected in the movement of groundwater and evidenced by the change in groundwater found in mine tunnels and adits over the years. This theory, probably the more likely of the two, proposes that there will be a cumulative effect on the groundwater due to infiltration from both pits. The impact, however, will be small due to the small area proposed for mining and no measurable cumulative impact is expected to surface water from either or both projects. The utilization of berms, ditches and impermeable barriers is expected to prevent deterioration of surface water from the waste ponds.

e. Other

The addition of mine personnel to the existing communities of Zortman and Landusky will increase land use change. Present vacant land within each townsite will be reverted from vacant or unused stations to residential or commercial use. There will be a small zone of affected groundwater containing percolated affluent from sanitary waste disposal systems. This will include individual septic tanks and drainfields, and be of greatest concern in Landusky where water wells are of

shallow depth.

During the transport of reagents used in the leaching process it is possible that a spill could occur. The significance of a reagent spill would reflect the amount of reagent involved, location of the spill, climatic conditions at the time of the spill or before cleanup can occur, and the nature of the spill itself, cumulative or sudden. Transport of the reagents to the facility sites will not occur during adverse road conditions, a precaution proposed by the mining companies to reduce the potential for reagent spills. The general lack of surface water along the haul route and the ephemeral nature of the drainages crossed will further reduce the threat for adverse impacts should a spill occur.

Sodium cyanide will be supplied in granular form. Spilled granular material must be completly swept onto a shovel and returned to the container or preferably used immediately (Manufacturing Chemists Association, 1967).

B. The Biological Environment

1. Flora

The major impact to the flora is the destruction of the vegetation in all disturbed areas of the proposed operations. Areas where the vegetation would be removed include the pit areas, waste areas, facilities, roads, and leach pads. Appendix E lists acreages of vegetation removed by community type and type of disturbance. The lodgepole pine community types and the Ponderosa pine/kinnikinnick type would be most affected. These areas generally support non-commercial post and pole stands.

Neither area is currently being grazed by domestic livestock and consequently there would be no impact on existing use. The grassland community type and the Ponderosa pine/grass community type do, however, have the capability to support limited livestock use and the area of these types affected would be removed from the range resource for the life of the operation. The areas of these types are small and comprise 1.2. AUMS for the Zortman permit area and 1.4 AUMS for the Landusky permit area.

Although relatively unimportant for domestic livestock, the two proposed permit areas do provide habitat for wildlife. WESTECH Inc. (1979) found that "mule deer were distributed rather evenly in proportion to habitat abundance" and that bighorn sheep were also observed in most community types, most frequently in the Landusky permit area. Browse and cover in the disturbed areas would be removed and deer and sheep would be displaced until the areas were revegetated and valuable food plants were reestablished. Previously disturbed sites in the two proposed permit areas have recovered from perturbations and do provide food and cover for wildlife. Based on past recovery of disturbed areas and on proposed reclamation techniques in the applications for permit, the potential for successful reestablishment of wildlife habitat should be enhanced.

The diversity of plant communities in affected areas would be reduced. Many of the species currently occupying important roles in these communities are not available commercially and their presence on reclaimed areas would have to occur through natural reinvasion. Depending on the species and site characteristics

this could involve a long time. The grassland is the most diverse type, however only 3.27 acres would be affected in the Landusky permit area with 2.53 acres disturbed in the Zortman permit area. The Ponderosa pine/grass is next most diverse type with 2.82 acres to be disturbed in the Landusky area. Areas this small will have a better chance of rapid natural reinvasion because of the shorter distances seed has to travel. The lodgepole pine types and the Ponderosa pine/kinnikinnick type would be most affected, however diversity is lower in these types. A loss of species diversity should not affect production or ground cover in revegetated areas.

A number of undesirable invader species are present in the areas as a result of past disturbances (mainly fire, mining and roads). These invaders will probably proliferate on disturbances caused by the operations and, although they will have the beneficial aspect of holding soils and building soil organic matter, they have the detrimental properties of competition with more desirable species and propogation of a seed source for further distribution.

Native vegetation and reclamation areas in the vicinity of the pits, waste areas, soil stockpiles, leach pads, facilities and along roads will be impacted by dust. Dust arising from these activities will affect vegetation to an unknown degree. It is expected that dust from all operations except roads will not be significant enough to cause damage. Road dust accumulation may affect the photosynthetic process causing a decrease in distribution of sensitive species. This possibility will be offset by the planned watering of roads to reduce dust. Wind blown leaching solution may affect the vegetation adjacent to the heaps, although the nature, magnitude and duration of the impacts are not known.

Increased off road vehicle travel associated with the mining operations could create localized soil compaction, crushing and uprooting of plants and increased sedimentation. This would most likely occur in flatter grassland or open forested areas in the southern third of the Landusky permit area. Because of the steep slopes and dense forest over most of the permit areas, damage is expected to be minimal.

The increase in people associated with the proposed operations will cause increased fire hazard and increased local demand for wood products (firewood, posts, poles, etc.). The amount of increase in wood products demand with the work force invisioned for the operations will probably not be significant. Increased fire hazard may be significant. The Little Rockies are susceptible to fire and have a definite fire history. Large scale conflagrations would likely cause more environmental impacts than the proposed mining and leaching operations.

2. Fish

No significant impact is anticipated to occur to the area's fishery, primarily because of the general lack of a fishery in the area of the proposed operations. The toxic affects upon fish should process waters or reagents used in the leaching operation reach waters that contain fish is discussed in the water resources impact section.

3. Terrestrial Fauna

a. Herpetofauna

Populations of reptiles and amphibians may decline locally from habitat destruction within each proposed permit area, but their study area populations will be little affected.

b. Birds

All bird species identified during the first three seasons of study may be divided into two general groups; those with relatively large ranges during the breeding season, and those with relatively small ranges.

The first group is generally similar to the highly mobile mammals. This group includes most of the raptors. Since there are no known eyries within either permit area, and since these species use a relatively large geographic area to satisfy their prey requirements, the loss of habitat and prey base within each permit area is not considered critical.

The second group of birds corresponds to the endemic group of mammals. Their dependence on small areas of habitat suggests that their populations may decline locally from the loss of habitat within each permit area, but that their study area populations will be little affected.

c. Mammals

(1) Rodent-like Mammals

Species with small home ranges or low mobility (small mammals, rabbits, yellow-bellied marmots) will suffer from the habitat loss. They will either be killed during disturbance, or they will move to undisturbed sites. At those sites, they will either fill unoccupied niches, or die.

All the species within this group in the study area have high biotic potential, extensive distribution and large regional populations. Therefore, the loss of those individuals and the habitat involved is insignificant in respect to their study area populations.

(2) Carnviores

Highly mobile species such as the coyote and black bear will not likely be affected by the habitat loss of either proposed permit area. The small size of the proposed permit areas compared to the large home ranges of such species imply that these areas are not critical to those species. There were no known dens of such species on either area, further reducing their importance. Loss of the prey base and increased human disturbance in each permit area may modify home range sizes and behavior patterns of several individuals, but the sum effect of these impacts on the study area population is expected to be small.

(3) Ungulates

(a) Mule Deer

Both proposed permit areas are part of mule deer summer range. The proposed Zortman permit area is about 274 acres, and the proposed Landusky permit area is about 256 acres. Since the entire mountain range is summer habitat, loss of about 530 acres of mule deer summer range is not considered critical.

Winter range is more important than summer range because there is less of it, less food within it, and more severe climatic conditions taxing the animals' stamina. The proposed Zortman permit area is not winter range. The proposed Landusky permit area may be winter range for part of the season, or for the entire season during mild winters. The proposed Landusky permit area probably is not critical winter range. Loss of about 256 acres of secondary or marginal winter range is probably of little importance to the study area mule deer population.

(b) White-tailed Deer

Neither proposed permit area has been identified as white-tail summer or winter range. Complete disturbance of the surface within the proposed permit areas will have no effect on the study area's white-tailed deer population.

(c) Bighorn Sheep

The proposed Zortman permit area appears to be low quality bighorn ram summer range. Loss of this habitat is expected to be insignificant. The proposed Zortman permit area probably is not winter range, so its loss probably will be insignificant.

At least part of the proposed Landusky permit area is ram summer range, and the adjacent Gold Bug Butte appears to be an important summer use area. Loss of the summer habitat within the permit area may be reflected in the bighorn population in one of three ways. First, it may have no effect. Since carrying capacity is exceedingly difficult (if not impossible) to quantify, the carrying capacity of summer range in the Little Rocky Mountains, and of Gold Bug Butte in particular, is unknown. If the bighorn population is well below carrying capacity, loss of a small amount of summer range will have no effect.

Second, if the bighorn population is at or near carrying capacity, the loss of any summer range may be detrimental. The population could be expected to decline.

The third possible impact is that there will be no noticeable short-term effect of habitat loss, but that there may be a short or long-term displacement of sheep from the adjacent summer range. No effect in the short-term is due to the fact that the sheep population in the Little Rocky Mountains is relatively new, and has probably neither stabilized nor reached carrying capacity. This assumption is supported by the lack of evidence or sightings of sheep in other parts of the study area that appear to be desirable sheep habitat, and by the fact that sheep expand their range through social organization rather than individual exploration.

Short or long-term displacement will be the result of the sheep population's intolerance of human disturbance beyond some unquantifiable amount. Since the habitat quality of the current sheep range is unknown (i.e., whether or not it is optium, good, marginal, bad, etc. sheep range), it is impossible to predict whether the sheep will disburse to range of better or worse quality. Therefore it is

not possible to predict whether or not such displacement will be detrimental.

The proposed Landusky permit area may be bighorn sheep winter range for part of the season, or for all of the season in mild winters. It does not appear to be critical winter range and is expected to be of little importance to the study area bighorn population.

4. Impacts Other Than Habitat Loss

Other impacts to terrestrial wildlife from mining development would be:

1). Increased human population (housing developments). The degree of impact will depend on the number of housing units erected and the location of housing developments. Housing developments within the towns of Zortman and Landusky will affect small mammals and birds more than large mammals. Housing developments outside of town have more potential impact on large mammals than those within town. Developments on either summer or winter range of big game species, for example, lower the carrying capacity of that range. Actual big game populations may not be affected if they are well below carrying capacity, or if the species of concern does not use that part of the range to be affected. Such impacts cannot be qualified without knowledge of the number of housing units and location of housing developments.

2). Increased hunting pressure (legal and illegal) will be a result of increasing human population and/or increasing public knowledge of the hunting potential in the Little Rocky Mountains. Since past hunting pressure has never been quantified (and therefore the effects of hunting on wildlife have never been estimated) the impact of increased hunting in the future cannot be predicted.

3). Increased harassment. Also a result of increasing human population and mining development, this category includes such impacts as wildlife loss to traffic, and wildlife displacement away from towns, roads or recreation sites as a result of noise or human presence. Traffic loss is expected to be insignificant to study area populations. The impact of displacement varies by species, since each wildlife species has a different level of tolerance for disruption. This impact is impossible to predict, but in general it may be stated that sensitive species (such as some species of raptors) will be affected more than less sensitive species (such as small mammals).

4). Future mine expansion. If economic conditions remain favorable to mining, both proposed permit areas might be increased at some time in the future. The presently proposed permit areas comprise about 530 of the study area's approximately 21,000 acres, or about 2.5 percent. The impacts of future mine expansion on terrestrial wildlife will then have to be evaluated in respect to the actual amount of expansion, the geographic direction of expansion, the success of reclamation upon previously disturbed sites, and the increase (if any) in human population.

The actual amount of expansion refers to the percentage of habitat lost, assuming no reclamation success. At some unknown point, enough habitat will have been destroyed so that carrying capacity of the study area for any given species or group of species will be dramatically reduced. Because wildlife populations

change with time, this impact cannot be predicted with any degree of specificity until the expansion is planned, and some form of wildlife monitoring can be initiated.

The geographic direction of future expansion refers to the kind of habitat lost. If, for example, the Landusky mine expands north (away from Gold Bug Butte), the impact to bighorn sheep might be small. If Gold Bug Butte is disturbed, however, the impact to bighorn sheep will be considerable.

The success of reclamation will act in some degree to offset future disturbance, since a largely barren disturbed habitat will be replaced with one in some form of early succession. Productivity of reclaimed sites cannot totally replace the habitats lost, but will help compensate the loss.

Any increase in human population as a result of future mine expansion will magnify the impacts discussed earlier.

C. Social and Economic Impacts

1. Overview

The proposed mining operation is estimated to have a life expectancy of 20 years. If so, it will have many long-term effects on the Zortman-Landusky area. The mining operation utilizes a hybrid cyanide leaching technology that is to be applied at a scale greater than it has previously been utilized.* The project is being proposed at a time when gold prices are at record highs. Whether the leaching process will prove economical may depend on whether the price of gold maintains its high value.

The mining companies would like to begin their operations in the summer of 1979. Initially, mining will occur at a rate of 1,000 tons a day. In this early phase much of the manpower and equipment utilized in the operation will be contracted for, rather than provided directly by the mining company. As production is increased the companies intend to integrate more of their own resources into the production process. It is clearly the intention of the mine managers to reach a mining level of 5,000 tons a day of total material at each operation during those months that mining can occur. At this level the companies will utilize only their own manpower and equipment (DuVall, Frank 1978).

It is uncertain how rapidly the company will step up production. Economies of scale exist within the production process which imply that return per dollar invested would be proportionately greater at higher output levels (Williams, Rod 1978). This provides an incentive to accelerate the rate of production as rapidly as possible. A timely increase in the price of gold could serve to motivate the commitment of capital necessary to increase production. For purposes of analysis, it is assumed that the mines will begin mining at the 5,000 ton a day level in 1981 or 1982.

At a mining level of 5,000 tons a day, for each operation, the operations will employ 40 persons (Sholz, Ed 1978). Between ten and twelve of these positions will be management personnel and highly specialized technical people, such as engineers and chemists. Most of the remaining jobs will be for heavy equipment operators and maintenance personnel. The lowest wage paid by the company is $5.00 per hour, the

* at the Landusky Site.

median wage is over $8.00 per hour. Current non-mangement personnel are not members of labor unions.

2. Phillips County Population

Table III-1 displays population projections for Phillips County during the 20 year life of the Zortman and Landusky Mines. The table demonstrates that irrespective of mining in the Little Rockies, the county is likely to experience some population growth. Projections based on bentonite development indicate the county will grow by five percent in the next decade. This is a manageable county-wide growth rate, although concentrated growth in the early 1980's may produce short-term service delivery problems for local governments.

The Zortman-Landusky projects would contribute incrementally to the population growth. Mining at the lower than anticipated levels of 1,000 and 3,000 tons a day for each operation would collectively generate 28 and 85 people respectively. At the companies desired level of production the mines would add 142 persons to the county's population. At this level of production, the county's population would grow by an additional 2.4 percent, causing an aggregate increase of eight percent.

Table III-1: Population Projections - Phillips County, Montana 1970-2000 (John Short & Associates, 1979).

| | 1970 | 1978 | 1980 | 1985 | 1990 | 1995 | 2000 |
|---|---|---|---|---|---|---|---|
| Scenario 1 Permits Denied | 5386 | 5500 | 5575 | 5796 | 5926 | 6050 | 6196 |
| Scenario 2 Mining 1000 TPD* | 5386 | 5500 | 5593 | 5824 | 5935 | 6068 | 6205 |
| Scenario 3 Mining 3000 TPD* | 5386 | 5500 | 5593 | 5881 | 6013 | 6149 | 6287 |
| Scenario 4 Mining 5000 TPD* | 5386 | 550 | 5593 | 5938 | 6071 | 6208 | 6348 |

* at each operation.

3. Zortman-Landusky Population

Approximately 150 people currently live in the 570 square mile Zortman-Landusky area, thus even a small numeric increase in population is likely to have a proportionately greater effect. Population projections displayed in Table III-2 indicate mining activities would cause major relative increases in the areas population.

The Little Rockies have been experiencing population losses since 1920. Mining would reverse this pattern. At a mining rate of 5,000 tons a day for each operation the area would grow by 105 people by 1985. This, the most probable level of production, means the area would grow by 70 percent, and would likely result in substantial changes in community characteristics (David Williams, 1976).

Table III-2: Population Projections - Zortman-Landusky, Montana, 1970-2000 (John Short & Associates, 1979).

| | 1970 | 1978 | 1980 | 1985 | 1990 | 1995 | 2000 |
|---|---|---|---|---|---|---|---|
| Scenario 1 Permits Denied | 162 | 150 | 149 | 144 | 139 | 139 | 129 |
| Scenario 2 Mining 1,000 TPD* | 162 | 150 | 164 | 172 | 176 | 175 | 174 |
| Scenario 3 Mining 3,000 TPD* | 162 | 150 | 164 | 216 | 223 | 228 | 223 |
| Scenario 4 Mining 5,000 TPD* | 162 | 150 | 164 | 255 | 257 | 259 | 260 |

* at each operation.

4. Other Areas

The purchasing patterns of persons employed by the Zortman and Landusky mines would generate some minor population effects in other areas. Malta and Lewistown serve as trade centers for the Little Rockies area. Mining induced ancillary employment would add approximately 32 people to Malta's population. This growth will augment the sizeable growth which bentonite development is likely to funnel to Malta. In Lewistown (a much larger city) the small amount of population growth potentially induced by the mining would be insignificant.

The mining operation would not be expected to change population patterns on the reservation as reservation employment is not expected to be high. Regardless, the underemployed labor force in the southern end of the reservation could absorb mining jobs locally.

5. Population Characteristics

a. In-migration

The labor force of Zortman and Landusky can fill only a small portion of the 40 jobs suggested by mine management. In the Malta area competition for labor is likely to be great, as American Colloid Company will be filling 110 jobs by the early 1980's. The mining company has stated its preference to hire as many local

people as possible; however, these two factors imply that the mining company may need to hire people from outside the immediate area.

Many job descriptions for the Zortman-Landusky operation are similar to those of Montana's recently initiated coal mining operations. Persons moving to the impact area are likely to share many characteristics with those who moved to southeastern Montana. In-migrants are likely to be young white adults, and initially, there will be more males than females migrating to the area.

b. Social Characteristics

Because the existing population is small, the potential in-migration of 105 people by 1985 would greatly alter the demographic profile of the Zortman-Landusky area. A primarily agriculturally oriented population would initiate changes in the social and economic patterns of the area. This population would likely exhibit more youthful consumption, recreation, and travel patterns, and possess different needs and expectations from local government.

6. Employment

a. Basic Employment

In the late 1970's the Phillips County economy has been temporarily buoyed by major pipeline construction projects. More long-term basic employment is promised from bentonite development in the area. The cumulative impact of jobs in gold and silver mining and bentonite production would strengthen the economic constancy of the area. In addition to the jobs themselves, greater diversification in the county's economic base would make its economy less vulnerable to annual fluctuations in the viability of agriculture.

A risk often connected with gold mining is the volatile nature of the industry itself. This type of mining shows a historic pattern of boom and bust cycles. The history of the Little Rockies provides ample evidence of this trait. If employment levels in Zortman and Landusky are to vacillate with changes in the price of gold, the operation will not contribute to the stability of the area's economy. Countering this concern is stability in ongoing operations of a similar nature (Williams, Rod 1978).

No other significant basic industrial activity is known to be planned for Phillips County.

b. Ancillary Employment

Ancillary employment has grown modestly in the 1970's in spite of a stable basic economy. The creation of 40 basic jobs in the Little Rockies region will generate additional ancillary employment in and around Phillip's County. Examination of the existing basic ancillary employment relationship in Phillips County indicates that the derivative effects of basic jobs in the area are relatively low. This low derivative effect is understandable because the multiplier effect increases as the size (population) of an economic system increases. Small service sectors are not able to circulate basic income efficiently. Assuming that the ratio is accurate, the projected 40 basic jobs generated by the mining

development should create a total of 39 ancillary jobs.

Zortman provides very little in terms of service sector type services and Landusky provides no services. A trade area of 150 people is too small to support most types of service establishments.

Current residents do their shopping in both Malta and Lewistown. These trade patterns are likely to continue should mine induced employment occur.

A gravity model is a useful tool for predicting shopping patterns between rival service centers, as the model considers both travel distance and the quality of shopping services provided (a function of population). The model indicates that Lewistown is likely to capture the greatest percentage of trade generated by Little Rockies population growth. This is verified by a county commissioner comment regarding existing trade patterns of area residents (Phillips County Commission, 1978). The model does imply the miners would generate additional economic activity in Malta and Zortman. Using the basic/non-basic ratio developed earlier the mining would create 13 additional ancillary jobs in Malta and five in Zortman. The remaining 21 ancillary jobs would be created in Lewistown.

The development of ancillary employment does not occur simultaneously with the creation of basic jobs. Montana's experience with coal development in southeastern Montana implies that it may take several years for ancillary employment to reach equilibrium with the basic sector. In Zortman this period may be further prolonged by the "wait and see attitude" of the towns current businesses. Both the general store and bar restaurant owner expressed reluctance to make investments in anticipation of mining related population growth. The basic ancillary employment forecasts developed for each scenario through the 1980-2000 period were then utilized by an estimated average family size factor of 2.45 to calculate the resulting population forecast adjustments described earlier.

c. Labor Force

The Zortman and Landusky Mining Companies have expressed a strong desire to hire as many local people as possible. Several of its current employees are from the immediate Little Rockies area. However, this is a very small labor pool and its potential for filling mine related jobs is nearly exhausted.

The development schedules for the Zortman-Landusky project and the planned bentonite mine are similar. It is a distinct possibility that the two companies will be competing for the same labor pool and are likely to be forced to hire personnel from outside Phillips County. Regional labor forces centered in Havre, Glasgow and Lewistown could provide an ample labor supply.

Higher wages paid by major industrial developers are likely to adversely affect area ranchers and farmers. The viability of many small ranches and farms often requires the seasonal availability of low cost labor. Industrialization often reduces the availability of such workers. Rising labor costs have been cited by Southeastern Montana ranchers as the most severe problem attributable to rapid industrial development (Meadowlark, 1978).

The Zortman-Landusky Mining Companies have expressed a willingness to hire Indians

from the Fort Belknap Reservation (DuVall, Frank, 1978). This would serve to alleviate some of the very high unemployment at the south end of the reservation. However, many members of the tribe may be reluctant to work for the mining companies (Fort Belknap Tribal Land Committee).

7. Tax Generation

There are five separate taxes in Montana which apply to hard rock mining operations. These are:

Property Tax
Gross Proceeds Tax
Resource Indemnity Trust Tax
Metalliferous Mines License Tax
Corporation License Tax

The Zortman and Landusky mines share personnel, equipment and facilities, but are legally two separate corporations. As such, the Zortman Mine (Agro Gold Inc.) and the Landusky Mine (Pegasus Exploration, Inc.) will be taxed separately.

It is uncertain whether the Argo and Pegasus Companies will apply for status under Montana's Industrial Development Tax Incentive Programs. This program provides a 77 percent reduction in property and gross proceeds taxes for the first three years of a new industry's operation. A company is ineligible for the program if its operation has an adverse impact on government services. The Industrial Development Incentive Program is new and what constitutes an adverse impact has not yet been defined. Whether its tax incentive is applicable to the Zortman-Landusky mines is unclear. Other companies in the state are considering court challenges which could reconcile the question.

If the companies were to apply for the Tax Incentive Program and be denied eligability because of an adverse impact on government services, the law provides that the county commissioners can then require the companies to prepay three years of taxes. These funds would be available to the county for use on mitigations developed specifically for reducing the companies adverse impact on government services.

Table III-3 contains a summary of the estimated tax revenue that the mining companies would generate annually in Phillips County. Further discussion of the tax methodologies and calculation criteria can be found in the report prepared by John Short & Associates, 1979.

Table III-3: Estimated Annual Tax Revenue (John Short & Associates, 1979).

| Tax | Zortman Mining Co. | Landusky Mining Co. |
|---|---|---|
| Property Tax | 64,800 | 74,400 |
| Gross Proceeds Tax | 20,250 | 23,250 |
| Corporation License Tax | 101,250 | 101,250 |
| Resource Indemnity Trust tax | 25,000 | 25,000 |
| Metalliferous Mines License Tax | 71,900 | 71,900 |

8. Land Use

The mining operation is projected to ultimately add 142 persons to Phillips County. Ancillary economic growth is projected to add 32 people to the population of Malta. These people would represent only a fractional increase in the city's population and their appearance spaced over several years would not influence the city's land use patterns.

The remaining 110 additional persons are likely to settle in the Zortman and Landusky area. The travel distance from Malta (+50 miles) is thought to be prohibitive, though some mine employees may choose to commute the distance until an appropriate residence is located nearer the mine sites.

Settlement options in the Zortman-Landusky area are limited by physical, social and political constraints. Difficulty in obtaining water and disposing of sewage make lowland areas surrounding the Little Rockies undesirable for residential land uses. The rancher's association owning foothill land near Zortman is not interested in selling its land. BLM land policies make its land unavailable while reservation land is for all practical purposes unavailable for white settlement.

Zortman is probably the most viable of the three settlement options. Zortman offers some services (gasoline, general store, bar, and restaurant) and houses the mining company office. Furthermore, the townsite could be expected to experience modest growth in ancillary employment.

If Zortman can improve its water supply it will logically attract the majority of new settlement. Landusky provied no services and is more isolated than Zortman, but does have its own elementary school. Its lots are likely to sell more cheaply than those in Zortman and will not provide an initial water access constraint. The foothill land south of Landusky possesses no services and no initial access and thus site development might be quite expensive. Table III-4 displays settlement projections. In this table, settlement in Landusky and the foothill ranch property are combined.

Table III-4: Projected Settlement Distribution - Zortman and Landusky Areas (John Short and Associates, 1979).

| | Persons | Dwelling Units |
|---|---|---|
| Zortman | 70 | 27 |
| Landusky | 40 | 15 |
| Total | 110 | 42 |

Potential land use conflicts may arise in the foothill area south of Landusky where a subdivision has been proposed and ranching is still viable. Trespassing, roaming dogs, and gates being left open are common complaints of established ranchers. In-migration to Zortman and Landusky would re-establish old uses as well as create new ones. The location of new conventional homes, mobile homes, and rehabilitated homes and business structures would restore the communities.

The townsites of Zortman and Landusky are already platted. As such, re-development of previously established lots is not subject to review by the Phillips County Planning Board. The townsite's roads and land use configurations resulted from random development occurring during their earlier boom periods. These configurations do not take into consideration the many technological and lifestyle changes which have occurred since the turn of the century.

9. Housing Impacts

Should full operation of the mines occur, it is projected that an ultimate demand for 45 additional dwelling units would be created by mine employees and ancillary employment.

It should be stressed that this is only an estimate that will be substantially influenced by the companies production timetable.

If the demand for housing is phased, the increased burden for provision of construction labor will be lessened countywide.

Mobile homes are available from licensed dealers in both Havre and Lewistown, however, the shipping distances and condition of the roads may preclude shipment except in good weather.

Due to the fluctuations in the price of precious metals, the somewhat innovative nature of the extraction process and the job type for the majority of positions offered (heavy equipment operation) it is likely that most employees will require rental units rather than homes for purchase. Aside from the existing cabin and one mobile home in Zortman, there were no dwellings available for rent. This situation not only could create a difficult housing problem for the new employees, but also an inflated rental market locally that could particulary affect older and lower income residents in the towns.

10. Transportation

The effects of population growth in Zortman and Landusky on the road systems of Phillips County would not be serious. The addition of 45 households to the Little Rockies area could generate as many as 252 additional vehicle trips each day. This increase would not cause any highway or county road to approach its carrying capacity.

Additional road use might require minor design changes and would increase county maintenance expenditures on the roads. These expenses would be offset by mine generated tax revenues to the county. The use of BLM roads in the Little Rockies would also increase and the Bureau would probably experience increasing difficulty in enforcing road closures in the mountains. Increased use of Bear Gulch Road might create some road maintenance inequities for the reservation, as the tribe would receive no tax revenue from the mining project.

11. Government Services

a. Revenues and Expenditures

Population growth attributable to the Zortman-Landusky Mining projects

would increase the cost of providing government services in Phillips County. Using 1978 per capita expenditure levels, full mine production would increase annual county expenditures by $36,600, an increase of 2.5 percent. At population growth projected at mining levels of 1,000 and 3,000 tons, county expenditures would increase by $6,517 and $19,550, respectively. Whether these increases would create a financial hardship for the county government depends on the amount of additional tax revenue generated directly and indirectly by the mines.

Phillips County does not have a large industrial tax base. The largest portion of the county's tax burden is borne by its farmers and ranchers through property taxes. The Zortman and Landusky mines could provide a partial solution to the county's tax dilemma. The mines themselves, equipment and facilities used in the mine operations and the miners gross production of gold and silver would be added to the taxable value of the county. The real and personal property of the mine-induced population would also be added to the county's taxable value. In addition, proportional increases in county income would be derived from its minor revenue sources such as gasoline taxes, alcohol taxes and service and licensing fees.

Table III-5. Projected Annual Property Tax Generation for Phillips County Montana by Zortman and Landusky Mines (in 1978 Dollars) (John Short & Associates, 1979).

| Production Level | Mine Property Taxable Value | Gross[1] Proceeds Taxable Value | Individual Real & Personal[2] Property Taxable Value | Total Taxable Value | County Mill Levy | Property Tax Revenue |
|---|---|---|---|---|---|---|
| 1,000 Tons per Day | 192,000 | 60,000 | 33,000 | 285,000 | 57 | 16,245 |
| 3,000 Tons Per Day | 576,000 | 180,000 | 99,000 | 855,000 | 57 | 48,735 |
| 5,000 Tons Per Day | 960,000 | 300,000 | 165,000 | 1,452,000 | 57 | 81,255 |

[1] Assumes current price of gold.

[2] Assumes taxable value of real and personal property of $3,000 per household.

Table III-5 displays county property tax revenue generated at various levels of mine production. At full production the miners would increase the county property tax revenues by 10 percent. Additional annual property tax revenues of $81,225 are considerably greater than projected mine-induced increases ($36,000) in yearly local government expenditures. Surplus revenue could be used to upgrade the general

quality of services county-wide, or the county's expanded taxable value could justify a lower county-wide mill levy.

Caution should be used in interpreting projections contained in Table III-5. If the mining operation were granted status under Montana's Industrial Development Tax Incentive Program, its property and gross proceeds tax would be reduced by 77 percent for the first three years of operation. This would have the effect of lowering full prepayment production tax revenues by $55,000 in each of the three years. Instead of experiencing revenue surplus, the county would find itself in a worse position than it was in prior to mining. The problems created by a three-year revenue deficit would be most acute if the induced population were to require capital facilities in which large "front-end" investments were necessary. On the other hand, if the company applies for the program and is denied status (by the determination that the operation would have adverse impacts), then the County Commission could demand up to three years prepayment in taxes from which it would be authorized to withdraw money to ameliorate adverse impacts.

When projecting revenues, an assumption was made that a linear relationship existed between mine production and the taxable value of mine-related property. The mining company intends to contract out many of its required trucking, labor and heavy equipement operations at low levels of production. The equipment of the contractees may not be licensed and their employees may not live in Phillips County. This would reduce projected increases in the county's taxable value. Another assumtion was that concentration of gold and silver in ore at lower levels of production would be the same as at the level of 5,000 ton a day. At lower levels the company may choose to process the high grade or thus increasing productivity per ton. This would cause a corresponding increase in gross proceeds revenue.

The county commissioners have adopted a "wait-and-see" attitude regarding the mines potential for tax revenue generation. A widely fluctuating tax base could turn government financial management into a situation of extreme uncertainty, particularly in areas involving long-term financial planning, such as capital facilities planning and debt management. Both the bentonite operation and the pipelines can be expected to be consistent generators of tax dollars. This stability should help the county to absorb annual variations in its tax income from other sources.

b. Law Enforcement

The population growth of 142 persons (or 2.5%) induced by the proposed mines would be quite manageable. But because the mining and bentonite developments are scheduled to occur at approximately the same time, their cumulative effects could be much greater than their individual effects would be. The sheriffs department is understaffed. Even with the planned addition of another deputy, the departments ratio of deputies to population would be far less than the state norm. With projected population growth in the early 1980's this ratio would be just under a deputy per 2,000 persons; nearly double the state average.

In spite of its lack of law enforcement personnel, Phillips County typically enjoys a very low crime rate. Some reasons for this lie in the homogenuity of the areas population, low population density and its older than average age profile. Many in-migrants will have different social backgrounds than the indigenous popu-

lation. Furthermore, these will be younger people and young people tend to have higher crime rates.

Most of the population* induced by the Zortman-Landusky mines will settle in the vicinity of the mines. Even with the projected population increases for this area, its cumulative population would not warrant the stationing of a deputy in Zortman. The response time of at least an hour from Malta would continue to severely limit the quality of police protection in the area.

The population growth projected for the Little Rockies might increase the county-wide crime rate slightly, but it should not cause a major change.

An unresolved issue regarding the effects of mining on law enforcement and crime is related to recent felony crimes perpetrated against mining company property. It is uncertain whether this would become an on-going problem.

The Fort Belknap Reservation's reaction to the mining could provide source of difficulty for a county law enforcement official. Tribal leadership is strongly opposed to re-initiation of mining in the Little Rockies (Plummage, Jack, 1978). There is a possibility that this tribal resentment could manifest itself as a serious law enforcement problem in the mining area in the future.

c. Fire Protection

The Zortman-Landusky area currently has no fire protection, but will as soon as it repairs its fire truck and establishes a fire district. Where these boundaries are drawn will be important determinants of the quality of area-wide protection and the financial viability of the district.

The mining companies could be expected to subscribe for fire protection rather than have its mines included in the fire district's taxable value. Its subscription payments should make it possible for the district to upgrade equipment. Water pressure presents a potential problem for fire fighters in Zortman. If a fire were to occur in August of a dry year (the peak fire season) it is doubtful that the community's water system could supply sufficient water for the pumper truck to be effective.

Response time from Zortman to Landusky may be a problem in winter months, when the road through the mountains is closed. This could be a particularly severe problem if a mobile home fire were to occur due to the high rate of combustability of those units.

d. Water and Sewer

(1) Zortman

The water system of Zortman must be improved to support a larger population. Wells placed directly beneath the townsite produce unacceptable water. The townsite's two privately owned systems are at capacity and could not service the influx of 70 people projected for the community at full mine production. This influx of people would bring the townsites population to 94 in the early 1980's. At a peak summer use of 600 gallons per person, per day, the townsite would need a system capable of supplying 56,400 gallons daily. This calculation does not take into

* growth

consideration the additional storage which is advisable for fire protection.

The source of the current community water supplies are springs in the gulche above the city. The subsurface routes which this water follows to reach these gulches is uncertain. The mining company intends to acquire its water from sources above those of the townsite gulches. It is possible that the company's source of water would reduce the water flow in the springs supplying the townsite (Gartner, Ambrey 1978).

(2) Landusky

The water source in Landusky appears sufficient to supply projected population growth in the townsite. Soil conditions are also conducive to septic tank use. Caution should be used in the spacing of new residences as some existing wells are quite shallow, and concentrations of septic tanks could endanger these shallow water supplies.

(3) Lowland Areas

In many lowland areas conditions are unsuitable for use of either water wells or septic tanks.

e. Education

(1) School Age Population

The younger ages of the mine induced populations will cause this group to generate a proportinately larger number of school age children than the indigenous population. The population growth projected at full mine operation could produce 36 additional students in Phillips county, (John Short & Associates, 1979). Eight of these students would presumably live in Malta, 18 would live in Zortman and 10 would live in Landusky.

(2) District Enrollments

Table III-6 displays the distribution of enrollments among the various school districts. It is assumed that children from Zortman in grades 1-4 would attend the Robinson School, and thereafter would attend the Malta schools.

Table III-6: Projected School Enrollments for Selected Districts in Phillips County, Montana - Mine at Full Production (John Achort & Associates, 1979).

| | Enrollment 1978 | Mine Induced Enrollment | Total Enrollment |
|---|---|---|---|
| Malta Elementary | 307 | 10 | 354[1] |
| Robinson Elementary | 9 | 6 | 15 |
| Landusky Elementary | 6 | 6 | 12 |
| Malta High School | 278 | 14 | 329[1] |

[1] Includes projected enrollment increases due to Bentonite Development in Malta.

The projected additional enrollment of six students would cause a proportionately large increase in the student population of the Landusky School. The district is currently of marginal viability because of its low student population. Projected enrollments would serve to strengthen the district by increasing its number of students while not severely impacting its facilities.

The Robinson School would also incur a needed increase in school enrollments. Again the existing facility and faculty (1 teacher) could accommodate a projected growth of six students without requiring major changes. An inequity of increased enrollment in the Robinson School is that its district will receive no property tax revenue from the mining projects and the parents of its Zortman housed students will be paying taxes to the Malta District. These parents will be paying tuition to the Robinson School and will not be reimbursed by the Malta District.

The Malta Elementary and High Schools will experience enrollment increases of 10 and 14 students respectively. These enrollments represent incremental increases to schools which have been experiencing declining enrollments. By themselves, the students induced by mining do not pose any serious problems for the Malta Districts. A problem arises because the schools will also be affected by new students generated by the bentonite development. Bentonite mining could add as many as 75 additional students to the systems.

The Malta Elementary Schools could experience a cumulative enrollment increase of 47 students. The high school would have 51 new students. These higher enrollments would require the hiring of additional faculty and would amplify the shortcomings of current facilities and programs. The tax revenue generated by the Zortman Mine and the bentonite project would contribute additional revenue to the district which could compensate the district for additional expenditures over time. In the short-run "front-end" costs for capital improvement could create financing problems.

(3) Tax Revenue

The Zortman mine and the Landusky mine would be subject to Malta High School and Elementary School levies. The Landusky mine would be taxed in the Landusky Elementary School District. Table III-7 displays projected tax revenues generated directly and indirectly by the initiation of mining.

Table III-7: Projected Annual Property Tax Generated for Local School Districts by Zortman and Landusky Mines at Full Production (in 1978 Dollars) (John Short and Associates, 1979).

| | 1978 District Mill Levy | Mine Property Taxable Value | Gross Proceeds Taxable Value | Individual Real and Pers. Property Taxable Value | Total Taxable Value | Taxes To Be Paid |
|---|---|---|---|---|---|---|
| Malta Elementary | 37.09 | 480,000 | 150,000 | 119,523 | 749,523 | 27,800 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Robinson Elementary | 34.19 | 0 | 0 | 0 | 0 | 0 |
| Landusky Elementary | 42.81 | 480,000 | 150,000 | 45,477 | 675,477 | 28,917 |
| Malta High School | 23.08 | 480,000 | 150,000 | 11,864 | 749,523 | 17,299 |
| Dodson High School | 47.74 | 480,000 | 150,000 | 45,477 | 675,477 | 32,247 |

1 Includes State mandated levies of 25 mills for elementary district and 15 mills for high school districts which are used to fund the state foundation program.

2 Assumes taxable value of $3,000 per household.

3 Would receive tuition payments from parents of students.

Projections are based on mine out-put at full production. It could require a period of time for the mines to gear up to this level of output. The projections do not consider the possibility that the company would be granted status under Montana's New Industrial Development Tax Incentive Program. This status would reduce the revenues paid to schools by the mining company by 77 percent in the first three years of mining operation.

12. Health and Social Service Impacts

According to an Old West Regional Commission's 1977 report a population/practitioner ratio equal to or exceeding 1500:1 is considered medically underserved. Phillips County has a population/practitioner ratio of 7250:1. The national average is 660:1 (White, Irvin et. al).

Although the proposed project will not necessarily exceed a threshold level of service provision it will cumulatively and incrementally impact the present overburdened health delivery system and add to social service caseloads.

In addition, employees at the mine sites stand substantial health risks should serious injury occur, due to both the distance from medical services and the accident potential associated with heavy equipment, movement of rock, and steep terrain.

13. Social Change

a. Zortman-Landusky

In the Little Rockies, mine development would cause a 70 percent increase in population; a rate of growth which is beyond the capacity of the area to easily assimilate into its social structure.

In-migrants could be expected to have social backgrounds and demographic characteristics which would be different than indigenous residents of the area.

These differences would manifest themselves in contrasting interests and viewpoints.

The transformation would be most dramatic in the two townsites, where population growth is expected to be the most concentrated. The influx of people would reorient fundamental economic interdependencies within the townsite sector (i.e., from tourism and ranching to mining employees). The disruptions of informal patterns of association and lifestyle conflicts could leave indigenous residents with a feeling of loss of control or even alienation in their own community.

b. Race Relations

The initiation of mining is not expected to affect the social structure of the Fort Belknap Reservation, but it may affect Indian-white relations in the area. The tribe's initial reactions to the mining were negative.

Unless tribal attitudes regarding the mining change, the mining projects may contribute negatively to a racially tense situation.

Tribal opposition to the mining project would likely be resented by whites moving to the area for mine related jobs.

14. Archeological and Historical Resources

The survey of the proposed permit areas by the Mineral Research Center (1978) did not reveal the existence of any surface prehistoric material. The existence of subsurface prehistoric material, however, has not been investigated. The proposed mining operations may uncover buried deposits of prehistoric material during the development of the proposed facilities. Recovery of the resource would require alertness on the part of company employees. Those resources located under the leach heaps would, for all practical purposes, become less recoverable in the future since the heaps will remain in place following completion of the projects.

Recent vandalism and thievery have damaged some historic properties on the Ruby Mine Site. Several old buildings at the Ruby Mine Site are currently being used for machinery, ore sample, and chemical storage. The construction of new roads for machinery, ore sample, and chemical storage. The construction of new roads for mining operations may in the future destroy some existing historic structures. The laying of pipe; erection of power poles; and construction of future ore siltation ponds may destroy portions of existing historical sites if it is deemed that the route of said pipes, poles or ponds be on or through a structure or feature. Drilling operations, and the roads constructed to them, may ultimately affect structures and/or features on historical sites and isolated finds, since the drilling procedure is based solely on following subsurface ore veins and not upon avoiding historical objects. Current and future open-pit mining and blasting operations adversely affect the adits, shafts, holes, etc., of the Ruby "Glory Hole" area. Recent fires on mining company property have destroyed several historic structures in the Ruby Gulch area.

15. Recreation

An increase in the population of the area will result in additional use of the area's campgrounds. These campgrounds are presently overcrowded on peak use days and will become increasingly so with heavier use. Off road vehicle use is

presently increasing in the Little Rocky Mountains with local problem areas. The increased use of the area for this purpose could reduce the recreation experience of other users, primarily hikers and hunters.

The operation of the proposed facilities would not significantly affect the recreational resource of the area, although increased noise caused by blasting and heavy truck traffic could reduce the recreational experience in areas immediately adjacent the operations.

16. Visual

The proposed mining operations will not signigicantly impact the visual character of the area. The area has experienced large amounts of mining and exploration activity in the past that has altered the natural visual resources. Reclamation of the areas disturbed by the proposed operation will beneficially affect the visual character of the area since reclamation will involve areas that are presently unreclaimed.

## D. Significant Adverse Impacts That Cannot be Avoided if the Proposals Are Implemented

Perhaps the major adverse impact that cannot be avoided is the potential threat of the introduction to the area's surface and groundwater system of potentially hazardous substances through unplanned circumstances, such as empolyee error, facility malfunction, or act of nature. The potential adversity of the situation is further compounded by the lack of definite knowledge regarding the area's groundwater flow.

Because of the time constraints lack of previous data and the diversity of wildlife in the area, additional information would be necessary in order to accurately assess the potential for significant adverse impacts to the wildlife as a result of the proposed projects. In particular, additional information regarding the characteristics of the local populations of bighorn sheep would be useful in better determining the magnitude of the adverse impacts associated with the project.

There are very few unavoidable adverse impacts associated with the socio-economic aspects of this proposal, primarily because tax reveneues could be used to off-set major impacts on social services. The extent to which the company will finance solutions to the ancillary problems that an influx of mine-related population will generate also pre-determines the magnitude of impact on the area and the county.

Population growth will increase the cost of service delivery in nearly every public service category. In some instances, these costs will be covered or offset by attendant revenues, yet in others there is no present mechanism for tying costs to revenues or for providing front-end funding for impacts. In addition, there are social impacts for which there is no realistic prevention, such as an increase in crime.

Although some mitigation for the local housing demand has been suggested, vacancy rates are already low and rental units scarce. Lower income residents

may be unable to compete for available units and so be forced to move from the area.

## E. Relationship Between Short-Term Uses of Man's Environment and the Maintenance and Enhancement of Long-Term Productivity

The following discussion appraises the extent of long-term impairment or enhancement of resource values that would occur, given the proposed short-term mining of gold and silver in the Zortman and Landusky areas. In this analysis of trade-offs over time and trade-offs among resource values, short-term refers to that period of approximately 20 years during and immediately following the proposed operations when mining and reclamation are to take place. Long-term is that period during which consequent impacts, both adverse and beneficial, still affect the environment.

In consideration of the relationship between the proposed short-term use of the environment and the maintenance and enhancement of the area's long-term productivity, the possibility for failure of the proposed facilities must certainly not be ignored. The possibility of such a failure, however, as discussed earlier, is difficult, if not impossible to predict. Therefore, the reader is referenced to the earlier impact discussions, for an indication of the magnitude of the potential for the effects of a facility failure upon the productivity of each of the area's resources. The following discussion considers only the normal operation of the proposed facility.

### 1. Topography

The proposed activities would result in a permanent change in topography at the mine site, and leach site, thereby introducing long-term changes in related environmental factors affecting long-term productivity of the area. Changes in slope magnitude and slope aspect or direction would alter the local microclimate, producing corresponding changes in type, density and vigor of the plant cover. This in turn would affect infiltration, runoff, erosion and sedimentation and productivity or carrying capacity for wildlife.

### 2. Air Quality

Zortman and Landusky's proposed development, a short-term use, would increase the total suspended particulate and cyanide levels in the air during the development and operation of the project. The cessation of this activity and successful reclamation would end the impact on air quality directly related to the projects.

### 3. Mineral Resources

The proposed mining and leaching activity represents a short-term productive use of the mineral reserves; although, reclamation and recovery time for the environment may be substantial and the environment would not return completely to its original condition.

The long-term effect on the productivity of the locatable mineral resource present will be a decrease in productivity until the mineral resource of the mine is totally depleted.

4. Soils

Soil disturbances as a result of the proposed action would alter soil characteristics and probably cause some long-term decline in soil productivity. Soil losses would occur from accelerated erosion on denuded and disturbed areas during operation and reclamation. Also, organic content and biological activity in the replaced surface layer would be decreased by mining soil and by stockpiling. Although there may be some minor changes in the soil productivity, permeability, infiltration and depth, the basic soil characteristics would be present to sustain the long-term productivity of the soils.

5. Water Resources

Because of the uncertainty regarding the characteristics of the groundwater flow, the potential for either operation to have a long-term impact on the productivity or availability of the area's water resources is unknown.

At Landusky, the mining operation proposes to use a water supply of weak acid drainage that is currently unsuitable for many other purposes. At Zortman, operational water will have to be supplied by groundwater wells drilled near the site. Groundwater in the alluvium of Alder Gulch provides domestic water for some residents of Zortman. No feasibility study has been conducted to determine if adequate groundwater exists for both purposes.

6. Flora

The short-term use of the land to mine and process the mineral could result in a long-term loss of biological productivity depending on the methods and success of reclamation. If care is taken to salvage and replace all available topsoil, prevent erosion, and establish grasses, forbs, shrubs and trees adapted to the sites, post-mining biological productivity should eventually approximate existing productivity. In some currently unproductive areas, reclamation practices will tend to enhance productivity.

Species diversity will remain low after reclamation until natural reinvasion can increase the number of species occurring on the revegetated areas.

Forest succession is a long-term process and will require decades before diverse forests are present in disturbed areas.

7. Terrestrial Fauna

On a study area basis, the short-term use of a small amount of land to mine and process minerals will have little effect on wildlife populations. About 530 acres of the approximately 21,000 acre wildlife study area will be potentially disturbed; none of the disturbed acreage constitutes critical wildlife habitat, without which a given species population will decline.

Wildlife is a function of habitat. Habitat is a function of time. Habitat undergoes succession, gradually but continuously changing from one stage to another. Wildlife populations, in turn, change with the habitat. Any major disturbance of habitat interrupts this gradual succession, setting it back one or more stages.

Wildlife populations adjust to meet the change.

On a site-specific basis, the short-term use of the land to mine and process minerals is a major disturbance that will result in the long-term alteration of wildlife habitat on the areas to be disturbed. In effect, succession will begin all over on these sites. If revegetation was not attempted, it is reasonable to assume that it could be a very long time before habitats would develop and diversify enough to provide a stable environment for a diversity of wildlife. Reclamation promotes and enhances habitat diversity and stability on the disturbed lands.

8. Social Environment

The assessment of the effect on social values with the advent of the proposed mines has already been addressed previously. An attempt to compare the losses in social values against any gains that the mine would bring can only be judgemental. Such judgement will vary from individual to individual largely dependent upon each person's situation.

The most obvious social change would be population growth. Growth would bring new people, greater activity, generally more "urbanization", increased demand for public services and recreation facilities, greater housing needs, etc. To many existing residents who have selected a lifestyle of relative seclusion and slower pace, these changes would be detriment and a real loss in their quality of life. Others may view some or all the changes as beneficial.

The Zortman-Landusky area is presently virtually unsettled, recreation property. It has been projected that 110 additional people would reside in this area. This would necessitate new homesites, both permanent and temporary (mobile homes), and generally a partial destruction or infringement upon the existing aesthetics. Other areas, such as Malta and Lewistown would notice less social change from new population because they are already organized communities with the means to accommodate some growth.

This new growth may bring stability and added support for the social environment in the form of increased employment opportunities, public revenue resources and stimulus for economic prosperity. The productivity of the mining operation may, as a result, improve or maintain the social values of the area as they now exist.

9. Economic Environment

Phillips County's economic environment would undoubtedly receive direct stimulation through new employment and mining production. The mining activity may also attract new commerce and bolster what now exists in Phillips County. Thus, the long-term consequences beyond the mining lifetime may be favorable. On the other hand, without additional industry, a conclusion of the mining operation may lead to increased unemployment and economic decline. These opposite consequences are the gamble of any short-term industrial buildup. However, the projected length of mining productivity provides an opportunity to prevent the latter consequence through careful planning and economic promotion.

10. Archeological and Historical Sites

Archeological and historical sites or artifacts are nonrenewable and hence long-term resources. In the event that significant sites are not discovered and are destroyed during the mining process, the physical resource loss would be irretrievable. In addition to such a possible loss of physical resources, educational and scientific information regarding prehistoric environments and our cultural heritage would also be lost to both present and future generations.

The inventory and study of the survey area in the Little Rockies offered short-term use of the resources. Long-term use of the resources is the record of this statement, and the report by the Mineral Research Center, which also included maps and photographs of the specific survey area, and sites and historic isolated finds. Long-term use of the resources is also exemplified in the report in the form of a recommendation that the documentary evidence gathered therein be utilized in a consideration by the Zortman and Landusky Mining Companies, the Bureau of Land Management, and the people of Zortman and Landusky, Montana in coordination with the State Historic Preservation Officer to determine the feasibility of placing the Little Rockies as a whole into an Historic Mining District classification.

## F. Irreversible and Irretrievable Commitment of Resources

### 1. Mineral Resources

The proposed mining and leaching activity would irreversibly commit the oxide gold and silver ore body within the permit area to depletion. Mineral deposits are unique, highly finite and valuable features of the earth's crust, formed by slow processes still active today. Mining of the mineral resources is a depletion of a resource that will require millions of years to be replenished, possibly never (localized) in the same area.

This depletion must be considered in two phases: 1) the raw mineral resource in the ground and 2) the finished product mineral resource in use. The proposed action would reduce the mineral resources of the ore body as it exists in the ground; however, that raw mineral resource which is extracted mineral commodities is becoming increasingly necessary as mineral resources in the ground are limited. It is not currently possible to completely recycle mineral resources; it may never be. However, before the mineral resource in the ground is irretrievably and totally depleted, it may be possible to slow the overall depletion of mineral resources to a point where they only need be replaced when they are destructively used.

The rate at which the depletion of the mineral resource would occur must also be considered in terms of economics and the market values of the mineral commodities involved. Areas surrounding what is currently considered to be an economically exploitable ore body, although not economically significant now, may be exploitable in the future; therefore, depletion of the regions mineral resource may continue after the presently proposed mining activity is completed.

The land itself may be committed to other uses as a result of its initial commitment to the proposed action. Other uses for the mine may be identified and this would delay or halt restoration of the adjacent area.

2. Energy Resources

The proposed mining of gold and silver and the reclamation of disturbed areas at the proposed mine site would require the use of electrical power, liquid fuels in the form of diesel fuel and gasoline, ammonium-nitrate-base explosives, and structural and repair materials. In addition to power, fuel and explosives, an unquantifiable amount of chemicals and materials used in the mining and subsequent reclamation processes would also be irretrievably lost for other uses.

3. Water Resources

At both projects groundwater will be utilized for process water and make-up water in the leaching system. Potable water will be used by mine personnel and their families for domestic and sanitary purposes. Based upon field investigation and information supplied by the mining company, it is anticipated that 120 ac.ft./yr. of groundwater will be utilized in each project's pond system. This water will be drawn from the groundwater supply of the region and will be a resource removed from other potential uses. It is estimated that approximately one acre-foot will be used annually to bring each pond system up to its operational level. This water will have a consumptive loss due to evaporation and will periodically be brought back to its operational level by addition of more groundwater.

If a spill or seepage of process reagents or residues were to result in the contamination of the areas groundwater supplies currently used for human consumption in Landusky and Zortman, the commitment of this resource may be considered irreversible and irretrievable, depending upon the nature of the contamination.

4. Terrestrial Fauna

Unless the mine area and all associated facility sites are reclaimed to their condition prior to disturbances, and unless the human population and associated developments are reduced to the level at which they occurred during the pre-mine era, the potential for reduced carrying capacity and lowered wildlife population levels must be considered a partial irretrievable commitment of the wildlife resource.

5. Social and Economic

Irreversible socio-economic impacts associated with the proposals are generally the permanent commitment of land uses, the commitment of public service delivery and changes in traditional lifestyles and values.

If mine related housing can be removed or modified for future residential or commercial use, then an irreversible adverse impact can be avoided. If this does not occur and the mines cease production after a twenty year time period, the occurrence of a "ghost town" atmosphere, with little of the charm of historic structures, and the wastefulness of a service delivery system (time, cost, and materials) no longer serving the users for which it was built is a possibility.

The capital investment in plant and productive equipment at the mining termination is irretrievable and irreversible once committed, if no alternate usage can be found. Labor invested in construction and in mining ore is irretriev-

able once expended, but the labor commitment is reversible should a premature termination occur. Similar commitments and investments on a smaller scale may develop in the government, trade and service sectors of the local economy with congruent irreversible and irretrievable outcomes.

Such an investment and commitment of human and economic resources is required for any economic activity. But unless the venture fails, this is a beneficial and necessary application of resources to create new employment and new sources of personal income.

6. Archeological and Historical

Archeological and historical resources are nonrenewable. In the event that significant sites are discovered and enforcement of regulation is inadequate, archeological and historical resources could be irretrievably lost. In addition to the loss of physical resources, educational and scientific information regarding prehistoric environments and our natural and cultural heritage could also be lost.

Should the mitigating measures recommended be followed and if the historic mines and historic isolated finds be placed in a newly created Historic Mining District classification; the majority of historic structures in the Little Rockies survey area will still, eventually, totally deteriorate. With this knowledge, it is imperative that photographs, maps, and thorough histories of the structures be complied. This statement and the recommendation by Mineral Research Center that all old mining records from the Ruby Mine site be sent to Helena for deposit in the Montana Historical Society Archives are important steps toward formulating the history of the entire Little Rockies area.

## IV. MITIGATING OR COMPENSATING MEASURES

Three basic types of mitigating measures have been recognized as relative to the Zortman-Landusky mining proposals. They are: (1) measures required by Local, State, or Federal laws, regulations, or executive orders; (2) measures proposed by Zortman-Landusky as part of their mining and reclamation plan; and (3) other measures generally thought to have merit. The first two categories include those measures that are binding and must be implemented upon approval of the proposal and issuance of the various agency permits associated with the mining proposals. By attachment of stipulations, other measures comprising the third category may be required as part of the companies' reclamation plans in those instances where the permitting State or Federal agencies have the authority to do so. Inclusion of these other possible measures in the environmental impact statement affords a practical means of utilizing the expertise of agency members to identify additional measures that, if implemented, would further reduce adverse impacts of the proposal. Inclusion of these other mitigating measures in this statement in no way obligates the Zortman and Landusky Mining Companies or restricts the decision-making prerogatives of the State regulatory agencies.

### A. Laws and Regulations

#### 1. General Statement

The proposed mining operation must comply with all applicable regulations of Federal, State, and County agencies including:

Mine Safety and Health Administration
Montana Department of State Lands
Montana Department of Health and Environmental Sciences
Phillips County, Montana

Regulations enforced by the above agencies are variously designed to assure realization of the full and best interests of the public, to adequately protect the environment, and to achieve continuing highest productive use of the land consistent with surrounding land uses and management objectives.

#### 2. State Laws

Significant State Laws for mitigating impacts include:

(a) Montana's Hard Rock Law defines reclamation requirements necessary for Departmental acceptance of the applicants reclamation plan, as well as other mitigating measures including accomplishment of specific activities, inspections of mining sites to determine compliance with the reclamation plan, performance bonds, and an annual report of activities by the permittee. In addition, all fees, fines, penalties, and other uncleared moneys which have been or will be paid to the department of state lands under the provisions of this part shall be placed in the earmarked revenue fund in the state treasury and credited to a special account to be designated as the hardrock mining and reclamation account. This account shall be available to the department by appropriation and shall be expended for the research, reclamation, and revegetation of land and the rehabilitation of water affected by any mining operations.

(b) Montana's Clean Air Act (Chapter 39 or Title 69, R.C.M. 1947) and administrative rules adopted thereunder (subchapter 1 of Chapter 14, Title 16, Montana Administrative Code) defines air pollution and provides that the Board of Health and Environmental Sciences may prohibit

> *the construction, installation, alteration, or use of any machine, equipment, device or facility which it finds may directly or indirectly cause or contribute to air pollution or which is intended primarily to prevent or control the emmission of air pollutants, unless a permit therefore has been obtained from it.*

(c) Montana's Water Pollution Control Act (Chapter 48, Title 69, R.C.M. 1947) and administrative rules adopted thereunder (subchapter 10 of Chapter 14, Title 16, Montana Administrative Codes) charges the Department of Health and Environmental Sciences with the responsibility of regulating water quality by administering a permit system.

(d) The State Antiquities Act, (Chapter 25 of Title 81, R.C.M. 1947) which is administered by the Board of Land Commissioners and the Montana Historical Society, provides for the registration and protection of historic, prehistoric, archaeologic, paleontologic, scientific, or cultural sites and objects on State lands. It also provides that the Department is authorized to enter into cooperative agreements with private landowners to preserve, mark, maintain, excavate, or otherwise deal with such sites and objects upon such terms as may be agreed upon.

(e) The Montana Resource Indemnity Trust Act (Chapter 70 of Title 84, R.C.M. 1947, and rules adopted thereunder (subchapter 14 of Chapter 14, Title 42, Montana Administrative Code) provides for a tax on mineral production. The taxes are paid into the resource indemnity trust account. The trust account will be allowed to accumulate until it reaches the amount of one hundred million dollars, at which time the legislature is empowered to appropriate net earnings and all receipts for improvement of this environment and rectifying damages hereto.

3. Federal Laws

The mining companies must comply with standards and guidelines established by the Mine Safety and Health Administration to protect the health of employees involved in the mining and cyanide leaching process.

The Environmental Protection Agency is currently developing rules and regulations for the disposal of hazardous wastes, such as the abandonment of the cyanide leach heaps. It is anticipated that the regulations will be administered by the Montana Department of Health and Environmental Sciences. At such time as these regulations are finalized, the proposed mining projects would be required to comply with the required proceedures for heap abandonment and hazardous waste disposal.

4. Phillips County Laws

a. Property and Gross Proceeds Taxes

The facilities, including equipment and land of the proposed mining projects

would be subject to a property tax levied by Phillips County. The proceeds primarily would help fund the Malta school district and Phillips County. The gross proceeds tax is in effect a property tax on a mineral resource. It would be based on the dollar value of the ore extracted from the mine in any given year.

5. Local Ordinances

There are no significant local ordinances that would function to mitigate impacts from the proposed mining projects.

B. Reclamation Plans and Additional Mitigating Measures

The reclamation plans proposed by the Zortman and Landusky mining companies are presented in Chapter One. In addition, the following section contains those mitigating, compensating, or monitoring measures generally thought to have merit by the Department.

Among those measures considered as mitigation are those that involve the implementation of a different or varient plan of operations. Technologic alternatives and their possible application to the proposed Zortman and Landusky Projects are contained in Chapter Five.

1. Topography

General mitigation of impacts to existing topography would include;

(a) minimization of all cut and fill slopes through proper siting of all facilities to take advantage of existing topography,
(b) hydroseeding all cut and fill slopes in excess of 10 feet with seed mixture containing at least two legume species in the first appropriate season following completion of the cutting and filling,
(c) terracing of all mine waste dumps to enhance future reclamation efforts, and
(d) replacement of a portion of the mine waste dump material within the mined-out portion of the mine.

2. Air Quality

The operator should utilize, at a minimum, the following methods to control dust:

1) Reduce vehicle speeds,
2) load trucks in such a manner that ore would not be lost to create crushed ore dust on the road surface,
3) curtail the use of haul roads during unfavorable meteorological conditions if haul roads become significant sources of dust,
4) use of equipment present on the site to clear haul roads if dust producing material, such as spilled ore or overburden materials, presents a hazard to air quality, and
5) when the above control measures prove ineffective to suppress dust emissions from haul roads, the operator should sprinkle the haul road using a sprinkler truck with a 1,000 gallon tank.

To prevent the process solution containing cyanide and other compounds from becoming airborne in increased amounts during their application to the leach heap, the sprinkler system should be carefully controlled and reduced or shut down during windy periods.

### 3. Employee Health and Safety

Under provisions of the Federal Metal and Nonmetallic Mine Safety Act of 1966 (Public Law 89-577), MESA is responsible for the enforcement of the health and safety standards prescribed to protect the workers at all mine sites, which includes heap-leach cyanidation operations. With the signing of the Federal Mine Safety and Health Act of 1977 (Public Law 91-173), it became the responsibility of the Secretary of Health, Education, and Welfare and the Secretary of Labor to develop and promulgate improved health and and safety standards for persons working at mining properties. New and/or revised regulations will be implemented by the Mining Safety and Health Administration (MSHA) under the Department of Labor.

### 4. Disposal of Hazardous Wastes

Under provisions of the Resource Conservation and Recovery Act of 1976 (Public Law 94-580), EPA is responsible for the development of regulations and guidelines for disposal and management of all solid wastes, including mining wastes. EPA currently is conducting a detailed study on the adverse effects on the environment of solid wastes from active and abandoned surface and underground mines. Meanwhile, State and/or county governments where heap-leach cyanidation operations exist regulate the disposal or abandonment of cyanided ore heaps.

Montana has not implemented any rules and regulations regarding the disposal of hazardous wastes, having defered implementation until the EPA rules and regulations are finalized. Public hearings on the EPA rules are currently taking place. Therefore, at the present time the disposal of hazardous wastes from the proposed mining operations, such as used cyanide canisters and leaching residues does not require a permit if it occurs on private property. As a mitigating and preventive measure, it is suggested that the disposal of all hazardous wastes associated with the Zortman and Landusky leaching operation be done by a method and in a location fully approved by the Montana Department of Health and Environmental Sciences, and in compliance with all federal and state regulations in effect at the time of their disposal.

### 5. Soils

#### a. Mine and Facility Sites

In all areas to be disturbed as a result of the proposed facilities, all suitable topsoiling materials should be salvaged and stockpiled.

Stripping of topsoil for stockpiling will require equipment operators to use caution and personal judgement to avoid salvage of extremely cobbly materials. All of the soils have variable amounts of coarse fragments occurring within short distances. Equipment operators should be made aware of this.

Soil salvage should take place in two lifts--the first lift would include A horizon material to be stockpiled in one location and the second lift would include the remaining material, B and C horizons, to a coarse fragment content of about 65%. The latter would be stockpiled in a second location. These stockpiles should be graded to gradual slopes and seeded to stabilize them. During the retopsoiling of disturbed areas, the B - C horizon material would be spread on first, followed by the A horizon on the surface. The reclamation effort should include some rapidly establishing species, such as annuals, in the seed mix, and mulch to provide immediate stability, because this topsoiling material may present some erosional problems, especially on steep slopes.

In mapping units S1 and S7, mention is made of the inclusion of "undifferentiated alluvium" and "some moderately deep soils", respectively. If these soils are to be disturbed, the company should take note of their presence so that all available and suitable material from such soils will be salvaged.

b. Roads

All roads will be constructed according to county standards with regard to side and back slopes which include sloping, grading and seeding. The potential for erosion and sedimentation can be further reduced by:

1) using existing access roads where possible,

2) designing new roads and upgrading existing roads to adequately accomodate the largest and heaviest piece of machinery involved in construction,

3) reducing road grades wherever possible,

4) installing cross-drainages in roads with erodible soils and steep grades,

5) providing a natural vegetation buffer between roads and streams,

6) restricting wet-weather road construction, particularly on poorly-drained erodible soils,

7) prohibiting disposal of excess fill material within the high-water zone of streams,

8) routing surface road drainage onto the forest floor, preferably on benches so that sediment can filter out,

9) minimize the number of stream crossings, and

10) avoiding roads in marshes, bogs, and other areas of extreme wetness.

6. Water Resources

Those mitigating measures identified previously in the Soils sections for reducing the potential of erosion and sedimentation apply to the mitigation of surface water impacts.

Conscientious management of the mine and leaching facilities, to reduce the

potential for spills of toxic materials would be necessary to insure the continued existing water quality in the area. The following measures would reduce the threat for a spill of hazardous materials in transport or at the leach operation:

1) The reagent should be containerized in spill-proof containers, and transported in enclosed trucks.

2) Reagent transport should not be attempted if adverse road conditions are present.

3) Employees should have knowledge of contingency plan for spill in transport.

4) Equipment and reagents to neutralize spills should be conveniently located and their location well known.

5) There should be a timely cleanup of any spill.

6) Roads in steep or dangerous areas should be banked on the outslope to prevent vehicular accidents.

7) A periodic safety training or refresher course for personnel in handling, operations, or transportation.

8) Construction of protective measures against vandalism; being alert for its occurrence.

9) There should be a constant communication link between in-town base, precipitation plant, transportation vehicles.

10) Implementation of a surface and groundwater water monitoring program should occur before, during, and after completion of the project.

11) If degraded water quality is detected in groundwater monitoring wells, this water can be pumped and piped for containment and neutralization in either the barren pond or an emergency storage pond until the source of the leak is detected and repaired.

12) Development and dissemination of contingency plans by management to operators in the event of spills should occur.

The mining companies have proposed to break the hypalon membrane lining the process ponds after completion of the project and bury the liner along with the residues that may be present in the ponds. To reduce the potential for groundwater contamination as a result of the proposed procedure, two alternative methods of disposal should be considered. They are:

1) Removal of hypalon and pond residues to a disposal site approved by the Montana Department of Health and Environmental Sciences.

2) The hypalon, if left in place, should not be broken. A second hypalon membrane could then be placed over the pond membrane, effectively sealing the membrane and any residues it may contain. The membranes could then be

buried, and the surface reclaimed.

The operating plan for the proposed Zortman mine and leaching operation does not propose the construction of an emergency water pond such as is present at the Landusky site. The construction of an emergency storage pond at the Zortman facility site would greatly reduce the potential for the discharge of process waters from the leaching site in the event of unusual precipitation events. In addition, it would provide an emergency storage capacity for the process water in the event such capacity is needed, such as a breach in the barren or pregnant pond dam or liner or other event requiring storage of the process water in ponds other than the process ponds.

Other technologic alternatives regarding the reduction, neutralization, recovery or disposal of hazardous wastes associated with the proposed operations can be considered as potential mitigating measures to reduce the threat to the areas water resources. A discussion of other technologic alternatives is contained in Chapter Five.

Because of the uncertainty regarding the potential for adverse impacts to the areas water systems, and the implementation of regulations that may be in effect during or after completion of the proposed project, a major form of mitigation to prevent the entrance of hazardous materials into the areas water resources would be for the mining companies to seek approval from the Montana Department of Health and Environmental Sciences for all activities involving the handling or disposal of hazardous materials.

7. Flora

The following measures should be considered in addition to the reclamation requirements of the Montana Hard Rock Law and should provide mitigating measures enhancing revegetation success:

1) Species present in the proposed disturbed areas should be selected, when available, for use in reclamation. These species have demonstrated the capability to survive the climatic vicissitutes and site characteristics of the area.

2) Where feasible, commercial timber on proposed disturbed areas should be harvested. Slash should be properly disposed of to reduce fire hazard.

3) Graded slopes should be kept as gentle as possible to enhance reclamation.

Mitigation of potential impacts to vegetation is linked closely with the successful mitigation of the impacts to the soils resource identified previously.

8. Terrestrial Fauna

A direct relationship exists between the amount of land disturbed as a result of development and the impacts of such disturbance upon wildlife. A concientious effort to disturb as little land as possible would have the most immediate and long-lasting mitigating effects.

Additional stresses on the wildlife resource will occur from an increasing

human population. These additional impacts can be significant if not countered with sufficient planning and management. For example, housing developments should be controlled to avoid construction in critical wildlife habitats, such as big game winter range. Increased law enforcement may be necessary to regulate illegal killing of wildlife, and off-road vehicle restrictions and road closures on public land may be necessary to reduce accessibility to wildlife.

These measures could be coupled with more intensive wildlife management, particularly on public lands. Most of the study area is in public ownership, administered by the Bureau of Land Management for the declared purpose of recreation and wildlife. Management practices could therefore be instituted to increase the carrying capacity and actual populations of those species most likely to be affected by development, including all game species, raptors, and potential game species.

Additional mitigation measures include:

1) When possible, arrange work schedules so that shift changes do not occur at dusk and dawn.

2) Request personnel not to chase, handle or take home any wildlife, particularly young animals.

3) If possible, hunting within or around the permit boundary should be prevented. Access during hunting season should be restricted.

In addition, to reduce employee-wildlife encounters it is recommended that the mining companies consider providing a bussing service to transport employees from each of the townsites to the facility and mine sites. This would reduce collisions with wildlife and the potential for wildlife harassment.

Some wildlife species, such as bighorn sheep, because of their vulnerability to human development or habitat alteration, could continue to be monitored in the area where development is pending. If they were monitored prior, during and subsequent to mining development they could reveal a relative index to the change in the environment.

### 9. Social and Economic

#### a. Growth Management

The influx of population generated by mining employment naturally implies a series of interdependent impacts on service delivery, employment, social attitudes and characteristics and land use.

The responsibility for ascertaining the needed and desirable growth patterns for the Little Rockies area lies with the county government and local citizens. The communities are small enough that a town meeting approach to needs, desires and anticipated problems caused by re-opening of the mines is still a viable approach. Leadership for continuing this process could be assured by either the Phillips County Commission or by residents of the area.

b. Population

Population growth in and of itself is neither good nor bad, but would serve as the catalyst for a multitude of other effects caused by the proposed mining acitvity. By manipulating the amount of numeric population growth occurring, and the rate at which it occurs, the magnitude and intensity of impacts on the area's socio-economic environment could be controlled.

Population growth would be caused by the mining company hiring non-local people to fill jobs. An obvious solution to this situation would be the hiring of Indians from the nearby Fort Belknap Reservation. The reservation's labor pool is capable of filling nearly all the non-technical jobs which would be created by the mining project. Every full-time job filled by an Indian could reduce the population growth in the Zortman-Landusky area by approximately three persons and would have negligible effects on the reservation's population growth.

Another approach to managing population growth would be to stage the rate at which mine development occurs. By limiting the acceleration of production levels, employees could be hired more gradually. This would increase the possibility of hiring local people as each year a new group of high school graduates would enter the local labor market. An equally important consideration is that staged growth would reduce greatly the "shock effect" of in-migration; providing the community with a manageable time frame in which to make necessary service delivery, economic and psychological adjustments. The staging of development could be accomplished voluntarily through mining company policy.

c. Economics

The phasing of employment increases would provide a more manageable transition for businesses which currently depend upon the availability of inexpensive labor. If the non-availability of such labor can be foreseen at some point in the future, businesses can plan necessary adjustment.

The mining company can further contribute to the local economy by obtaining the dozen homes it intends to purchase from the reservation's established prefabricated home building industry. This is the one significant manufacturing activity on the reservation.

d. Land Use

There are currently no land use tools in affect which could minimize the adverse effects of growth in Zortman and Landusky. The lack of zoning, and general planning and building codes is probably due to both community attitudes, which would tend to oppose such controls, and the lack of any real previous need for such regulations. Therefore, as a general mitigation, it is suggested that short of adopting conventional controls, a phased and/or planned growth policy on the part of the county, in cooperation with the employment policies of the mining company, could accomplish similar land use goals. In addition, consolidation of sewer and water services could direct and consolidate growth on and around the towns of Zortman and Landusky.

By consolidating construction and development of services, agricultural land use impacts would be minimized, the cost of services to the county (e.g., road

maintenance) would be reduced, and the potential for solutions to municipal water and sewer problems would be maximized.

e. Housing

A mitigation that could serve a combination of housing needs would be for the mining companies to build housing for the first year projected need. The housing could be a mixture of modular or mobile homes, provided and/or rented by the company and sold or removed at the end of the mining operation. Or it could be a more permanent contribution to the area such as a cluster of cabins or semi-private dormitory that could be converted to tourist use at the end of the mining operations.

These alternatives serve four important functions;

(1) they ensure that a conversion of housing could take place so that the company would not lose its investment;

(2) that another "ghost town" will not be created by the mining activity;

(3) that as first year employees get established they may decide to buy land and build or secure alternative housing, freeing up their homes for in-coming employees; and

(4) it eases the burden on the existing community to provide rental units and so avoids displacement of current renters.

f. Law Enforcement

In order to compensate for the existing shortage of law enforcement officers on the county, as well as provide a more immediate response to criminal activity, the county could hire a part-time deputy to police the towns. The tax revenue generated by the mines would accommodate such an expenditure.

g. Water

In order for Zortman to accommodate its projected population it must seek out and develop its groundwater resources. This solution would require construction of a system to deliver the water from the mountains. This could be accomplished by a private vender, who could thereafter charge user fees for water service, or the mining company could provide the system.

h. Schools

The school district tax system of Phillips County could be reorganized so that the district which experiences increased enrollments will also experience increased revenue.

In the instance of the Landusky high school students, the Landusky students do not have reasonable access to the Dodson High School. District boundaries could be redrawn so that the Malta District would receive the tax revenue from the area where the Landusky mine impacts would be generated. The Malta School

system could then extend its bus service into the Landusky area.

i. Social Attitudes

The proposed mining project could cause a significant change in the social structure of the Little Rockies area. Disruptive effects on the lifestyles of indigenous residents would probably be resented by certain of these people. What the mining companies do to establish a rapport with existing residents of the area could play a major role in making the local population more accepting of in-migrants and the transitions they would cause. This could be accomplished through thoughtfully applied public relations within the area. Helping in civic improvements, assisting individuals and purchasing goods and services locally are examples of company actions which would contribute to establishing good will in the area.

The hiring of tribal members and the purchasing of homes from the tribes precut home manufacturing industry are examples of how the mining company can improve its relations with the people of the Fort Belknap Reservation.

10. Archeologic and Historic

The following mitigations are based on the field evaluation of the existing historic sites and historic isolated finds by Mineral Research Center personnel; Robert A. Murray's review and recommendations based on archival material and photographs; and an assessment of the uniqueness of the processes, structures, and engineering activities in the area by Larry Hoffman, registered mine engineer.

The nature of mining in the Little Rockies, as elsewhere in the west, must be considered in relation to the state of the cultural resources. As each new episode, or "boom" in the mining business began in the survey area, old structures were destroyed, new structures built, and new mining processes begun. There is no existing structure within the inventoried area that is over fifty years old. The following actions should be considered as mitigation measures:

1) Portable hardware related to earlier mining activity might be transported to an interested small museum for public display in the local area. These artifacts might be, for instance, the Ingersoll-Rand air compressor used in the 1946 slabbing operations of the Gold Bug Mine; the "screw feeder" from the Gold Bug mill that was one used as a "dry" for the miners; the small boiler from the August Mine area, and the gas pump, twelve meter mine ladder, and ore car with wooden wheels.

2) That an effort be made as soon as possible to gather all of the old mining records from the records or comptroller's office, Structure #11, at the Ruby Mine site for deposit in the Montana Historical Society Archives in Helena, Montana.

3) Samples of ore-bearing rock from the mine sites might be displayed along with geological explanations, and illustrations explaining the process of ore refinement, in an interested small museum for public display in the local area.

4) All existing structures should be protected by the mining companies and the BLM from further vandalism if possible and that they be allowed to deteriorate at their own rate. It might be advisable to set up a gate across the road(s) to the Little Ben, August area with accompanying warnings against trespassing on private property.

11. Recreation

The impacts on recreational opportunities could be reduced by proper planning and some specific mitigation measures. The present developed recreation facilities could be expanded and the facilities enlarged to handle increased use. Additional recreational facilities could be developed to handle the increased use. Company contributions for construction of some recreational facilities should be encouraged.

Efforts should be made to enhance the recreational opportunities in areas less frequently used, spreading the impact so that one area is not over used and overcrowded while another remains relatively unused.

## V. ALTERNATIVES TO THE PROPOSED ACTION

### A. Introduction

Alternatives that apply generally to the development of the mineral resources in Montana include those of an administrative nature as well as those involving alternate mining and reclamation plans, technological alternatives, and reduced consumption of energy.

### B. Administrative Alternatives Available To State Agencies

#### 1. Department of State Lands

##### a. Approval of the Operating Permit for the Life of the Operations

Section 10.(50-1210)(c)(2) of the Hard Rock Law provides that:

*The operating permit shall be granted for the period required to mine the land covered by the plan and shall be valid until the surface or underground mining authorized by the permit is completed or abandoned, unless the permit is suspended or revoked by the board* as provided in this act. The operating permit shall provide that the reclamation plan may be modified by the board*, upon proper application of the permittee, or department, after timely notice and opportunity for hearing, at any time during the term of the permit and for any of the following reasons:*

*(a) to modify the requirements so they will not conflict with existing laws;*

*(b) When the previously adopted reclamation plan is impossible or impracticable to implement and maintain;*

*(c) When significant environmental problem situations are revealed by field inspection.*

Section 11.(50-1211) of the Hard Rock Law provides that:

*The applicant shall file with the department a bond payable to the state of Montana with surety satisfactory to the department in the penal sum to be determined by the department of no less than two hundred dollars ($200) nor more than twenty-five hundred dollars (2,500) for each acre or fraction thereof of the disturbed area, conditions upon the faithful performance of the requirements of this act and the rules of the board.* In lieu of such bond the applicant may file with the board* a cash deposit, an assignment of a certificate of deposit, or other surety acceptable to the board.* Regardless of the above limits, the bond shall not be less than the estimated cost to the state to complete the reclamation of the disturbed land. A public or govern-*

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* Board of Land Commissioners, or such state employee or state agency as may succeed its powers and duties under this act.

*mental agency shall not be required to post a bond under the provisions of this act. A blanket performance bond covering two (2) or more operations may be accepted by the board.* Such blanket bond shall adequately secure the estimated total number of acres of disturbed land. When determined by the department that the set bonding level of a permit or license does not represent the present costs of reclamation, the department may modify the bonding requirements of that permit or license.*

*No bond filed in accordance with the provisions of this act shall be released by the department until the provisions of this act, the rules adopted pursuant thereto and this reclamation plan have been fulfilled.*

Suspension of Permit

Section 25.(50-1225) of the Hard Rock Law provides that:

*If any of the requirements of this act or the rules or the reclamation plan have not been complied with within the time limits set by the department or board* or by this act, the department shall serve a notice of noncompliance on the licensee or permittee, or where found necessary, the commissioner shall order the suspension of the permit. The notice or order shall be handed to the licensee or permittee in person or served by registered mail addressed to the permanent address shown on the application for a permit. The notice of noncompliance shall specify in what respects the operator has failed to comply with this act, the rules or the reclamation plan. If the licensee or permittee has not complied with the requirements set forth in the notice of noncompliance or order of suspension within the time limits set therein the permit may be revoked by order of the board* and the performance bond forfeited to the department.*

b. Denial of the Operating Permit

Section 14.(50-1214) of the Hard Rock Law provides that:

*A permit may be denied for any of the following reasons:*

*(A) The plan of development, mining, or reclamation conflicts with the state water and air purification standards;*

*(B) The reclamation plan does not provide and acceptable method for accomplishment or reclamation as required by this act.*

*A denial of a permit shall be in writing and state the reasons therefore.*

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* Board of Land Commissioners, or such state employee or state agency as may succeed its powers and duties under this act.

In addition, Section 15.(50-1215) provides that:

*A permit may be denied and returned to the applicant with a request that the application be resubmitted with a different plan for reclamation. The person making application for a permit may than resubmit to the board* a new plan for reclamation.*

2. Montana Department of Health and Environmental Sciences

a. Water Quality Bureau

(1) Denial of an MPDES Permit

Under Section (6)(b) of rule MAC 16-2.14(10)-S14460 ("Montana Pollutant Discharge Elimination System"), the Department of Health and Environmental Sciences may deny issuance of an MPDES permit based on the applicants apparent noncompliance with technical requirements outlined under Sections (5)(a)(i) through (5)(a)(vii) and following Department procedures outlined under Sections (5)(b) through (5)(i) of the same rule.

(2) Issuance of an MPDES Permit

Under Section (6)(a) of rule MAC 16-2.14(10)-S14460, the Department of Health and Environmental Sciences may issue an MPDES permit subject to conditions and terms prescribed in Section (7) and following Department procedures outlined under Sections (5)(b) through (5)(i) of the same rule.

(3) Short-term Construction Activities

(a) Authorization Under Prescribed Conditions

Under Section (6)(g) of rule MAC 16-2.14(10)-S14480 ("Water Quality Standards"), the Department of Health and Environmental Sciences may authorize, under conditions it may prescribe short-term activities that will cause turbidities to exceed those allowed by water quality criteria outlined in Section (5) of the same rule, provided that such turbidities are unavoidable.

NOTE: The Montana Water Quality Standards do not specifically authorize denial of short-term activities causing unavoidable turbidities in excess of the criteria. The standards do say (Section (6)(g)) that "no wastes are to be discharged and no activities conducted which, either alone or in combination with other wastes or activities, will cause turbidities to exceed those allowed by specific water quality criteria." Short-term activities conditionally approved by the Department of Health and Environmental Sciences are exceptions.

b. Air Quality Bureau

(1) Approval of the Construction Permit

MAC 16-2.14(1)-S1400(3) of the departmental rules and regulations adopted pursuant to the Montana Clean Air Act (Title 69, chapter 39, R.C.M. 1947) provides that:

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* Board of Land Commissioners, or such state employee or state agency as may succeed its powers and duties under this act.

*The application for a permit shall be accompanied by plans, specifications, and such other information as the administrator deems necessary except that the administrator may dispense with the submission of plans and specifications upon prior written agreement.*

S1400(11) further states that:

*Before any article, machine, equipment or other contrivance described in this regulation may be operated or used, a written permit shall be obtained from the administrator. No permit to operate or use shall be granted by the administrator for any article, machine, equipment or contrivance described in this regulation, constructed or installed without authorization as pursuant to these regulations is presented to the administrator and such article, machine, equipment or contrivance is altered if necessary, and made to conform to the standards set forth elsewhere in the standards and regulations formulated under authority of the Clean Air Act of Montana.*

(2) Denial of the Construction Permit

MAC 16-2.14(1)-S1400(12) provides that:

*The administrator shall deny an authority to construct, or permit to operate or use, except as provided in this regulation, if the applicant does not show that every article, machine, equipment or other contrivance, the use of which may cause the issuance of contaminants, or the use of which may eliminate or reduce or control the issuance of air contaminants, is so designed, controlled, or equipped with such air pollution control equipment, that it may be expected to operate without emitting air contaminants in violation of standards and regulations formulated under authority of the Clean Air Act of Montana.*

*In acting upon a permit to operate, if the administrator or a member of his staff finds that the article, machine, equipment or other contrivance has not been constructed in accordance with the authority to construct, he shall deny the permit to operate. The administrator shall not accept any further application for permit to operate the article, machine, equipment, or other contrivance so constructed until he finds that the article, machine, equipment or other contrivance has been constructed in accordance with the authority to construct.*

(3) Conditional Approval of the Construction Permit

MAC 16-2.14(1)-S1400(13) provides that:

*The administrator may issue an authority to construct or a permit to operate or use, subject to conditions which will bring the operation of any article, machine, equipment or other contrivance within the standards of this regulation, in which case the con-*

*ditions shall be specified in writing. Commencing work under such an authority to construct or operation under such a permit to operate shall be deemed acceptance of all the conditions upon receipt of a new application, if the applicant demonstrates that the article, machine, equipment or other contrivance can operate within the standards of this regulation under the revised conditions.*

(4) Renewal of Construction Permit

MAC 16-2.14(1)-S1400(7) provides that:

*(7) If the construction, installation or alteration for which a permit has been issued is not completed within two years from the date of issuance of the permit, a renewal of the permit shall be required.*

C. Alternative Technology

1. Underground Mining

Underground mining cannot be economically used to remove fractured oxide ores in either of the proposed mining areas. In addition, the location of these ores near the surface makes open pit mining the only feasible method. Gold ore bodies exist in sulfide zones that have been mined in the past using underground methods. These ores, however, cannot be processed effectively by the cyanidation process, are more expensive to mine and are not presently considered economically feasible.

2. One Ore Leaching Site

This alternative would essentially double the size of one plant and associated facilities while eliminating a second proposed processing unit. Economies of scale include increased storage and mixing facilities for chemicals, and additional groundwater monitoring and pond construction. A single facility reduces risks related to chemical spill or vandalism, and groundwater contamination, but failure of the larger pond facility would have a potentially greater impact on surface water quality. A single facility would require additional haulage roads and trucks, and associated dust, noise, and fuel consumption would be increased. The additional hauling distance involved is considered to presently prohibit a single processing unit for economic reasons. Also, a working arrangement would have to be developed to handle combined ores mined by Zortman Mining, Inc., and Landusky Mining, Inc.

3. Alternative Processing

It is the development of the cyanide heap leach system that makes the extraction of precious metals from low grade ores economically feasible. Activated carbon can replace zinc to precipitate gold in some cyanide operations, but it is ineffective in precipitating silver which is a significant value in the ore to be mined. Increased costs of crushing, milling and tank cyanidation plus environmental controls eliminate the feasibility of the leaching mills formerly used in the Little Rockies.

Amalgamation would be economically impractical due to the milling costs and environmental risks related to mercury losses. The cost of construction and operation of a smelter would also be too costly for the ore values involved.

4. Ore Processing at Existing Plants

There are no processing plants existing in Montana that could economically extract gold from the proposed mines, due to the low precious metal concentration and long transportation distances.

5. Alternative Monitoring

Drilling to deeper levels could be accomplished at great expense. An alternative to a deep monitoring well system could consist of providing containment of seepage, should it occur.

By locating the ponds on a fairly continuous layer of relatively shallow bedrock, several shallow monitoring wells could be drilled or dug and developed to bedrock down-gradient from the ponds. If bedrock underlying the process operation is highly fractured, artificial drainage can be provided by installing a packed bentonite pad overlain by gravel. This base would be the foundation for the normal pond construction consisting of another layer of bentonite and a plastic liner. The gravel and lower bentonite pad would provide a positive containment system that will prevent process water from entering the groundwater system or be lost to the circulation system. The system would simplify the groundwater monitoring network required and could conceivably save the operation money by containing and returning leaked solution.

6. Destruction of Cyanide

The following alternative methods for the destruction of cyanide are taken from the EPA publication "Recommended Methods of Reduction, Neutralization, Recovery, or Disposal of Hazardous Wastes", 1973.

Kastone Process. DuPont has introduced a process which appeals primarily to small plant operators using cyanide baths to plate zinc or cadmium. This process oxidizes cyanides to cyanates and simultaneously precipitates zinc or cadmium complexes by simple filtration. The Kastone Process uuses a proprietary peroxygen formulation that contains 41 percent hydrogen peroxide with trace amounts of stabilizers. The cyanates, though 1,000 times less toxic than cyanides, cannot be discharged into most natural streams. Therefore, this process has only limited application.

Electrolytic Oxidation. Automatic electrolytic oxidation units are marketed by Research Control, Inc., for complete decomposition of cyanide ion content in waste streams. Some difficulties have been reported with this unit for dilute solutions, but this problem has been circumvented by using a semiconductive bed in the cell. The bed serves as an intermediate electrode that provides in effect more than a million anode and cathode sites per cubic foot.

Radiation Decomposition. A patent has been issued for destroying cyanides by gamma radiation which serves to rupture the C=N triple bond and converts the cyanide ion into harmless by-products. This method is not in commercial use at present.

Conversion of Cyanides to Ferrocyanide by Ferrous Sulfate. The formulation of less toxic cyanide complexes such as ferro and ferricyanides has been used as a method for disposing of cyanide waste waters. This process involves the use of iron salts to form complex compounds with the free cyanide in the wastes. These cyanide complexes are precipitated and removed as sludge. The major advantage of this treatment method is that it is relatively inexpensive where waste ferrous sulfate is available. However, considerable quantities of sludge are formed, and the treated solutions are strongly colored. There is also evidence that ferrocyanides may decompose to free cyanide in the presence of sunlight. The regeneration of cyanide can then contaminate the receiving stream.

Reaction with an Aldehyde. A patent has been issued for the removal of cyanide from a waste stream by reaction with an excess of an aldehyde according to the following:

$$KCN + CH_2O \text{ (aqueous)} + H_2O \rightarrow HOCH_2CN \div KOH$$

$$CNCH_2OH + KOH + H_2O \rightarrow HOCH_2COOK + NH_3$$

It is claimed that nearly all cyanides, even stable complexes, are destroyed in this manner. However, though the reaction products are not toxic, there is the problem of disposal of the organic compounds formed.

Ozonation. Ozonation is reported to be more economical and easier to control than chlorination. Ozonation, however, oxidizes cyanides only to the cyanate in accordance with the reaction given below.

$$3CN^- + O_3 \rightarrow 3CNO^-$$

The oxidation of the cyanate is too slow to be practical.

Acidification. Waste acid solutions have been used to acidify cyanide waste solution. Air is then passed through the solution and the liberated hydrogen cyanide is discharged up a high stack or is passed through a burner. This method is not recommended because of the danger involved.

## VI. CONSULTATION AND COORDINATION WITH OTHERS

### A. Development of Statement

This environmental impact statement was prepared by the Montana Department of State Lands. Major inputs were provided by the following:

State Agencies
Montana Department of State Lands

Private Organizations
Western Technology and Engineering Inc.
John Short and Associates

Additional participation and assistance were obtained from many sources. Zortman and Landusky Mine Companies provided data and information on their proposed activities, as well as numerous visual aids. Comments of residents of the area and others were especially helpful in the preparation of this document.

### B. Review of Statement

In accordance with U.S. Council of Environmental Quality and Montana Department of State Lands rules and guidelines, copies of the draft statement are being made available to the public for their comments and suggestions.

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APPENDICES

A. Proposed Water Quality Monitoring Program

B. Seeding Recommendations

C. Birds of the Little Rockies

D. Mammals of the Little Rockies

E. Vegetation Acreage Disturbed by Proposed Operations

F. Geologic Symbols

Appendix A

Revised 2-2-79

# TENTATIVE WATER QUALITY MONITORING PROGRAM - LANDUSKY

| Station Code | Station Designation | Sampling Code (1) | Frequency (2) |
|---|---|---|---|
| L1 | Rock Creek @ Kolczak Road | C + CN | A |
| L2 | Montana Gulch @ County Road | S, C + CN | A, A |
| L3 | Gold Bug Adit Discharge | C | S |
| L4 | Rock Creek @ Landusky | S | A |
| L5 | King Creek Spring | C | A |
| L6 | King Creek at Reservation Line | C | A |
| L7 | Mill Creek at Mouth | C + CN | A |
| L10 | Landusky Town Pump | C + CN | A |
| L11 | Shallow Monitoring Well No. 1 | (C + CN)[3] | M |
| L12 | " " " " 2 | " | " |
| L13 | " " " " 3 | " | " |
| L14 | " " " " 4 | " | " |
| L15 | " " " " 5 | " | " |
| L16 | " " " " 6 | " | " |
| L17 | " " " " 7 | " | " |
| L18 | Deep " " " 1 | C + CN<br>P | S<br>M |
| L19 | Intermediate" " " A | C + CN<br>P | S<br>M |
| L20 | " " " " B | C + CN<br>P | S<br>M |

NOTES:

(1) P = Partial; S = Standard; C = Complete; See Table 6 for explanations.

(2) A = Annually, S = Semiannually; Q = Quarterly; M = Monthly; W = Weekly; D = Daily

(3) Checked weekly for water level. If water is present sample for a complete analysis plus cyanide.

Revised 2-2-79

# TENTATIVE WATER QUALITY MONITORING PROGRAM - ZORTMAN

| Station Code | Station Designation | Sampling Code (1) | Frequency (2) |
|---|---|---|---|
| Z1 | Ruby Gulch Below Old Mill | C + CN | A |
| Z2 | Alder Gulch Above Adit Discharge | C + CN | A |
| Z3 | Alder Gulch Mine Adit Discharge | C | A |
| Z4 | Pony Gulch Above Alder Gulch | S | A |
| Z5 | Glory Hole Creek @ Mouth | C | A |
| Z6 | Developed Spring Near Mouth of Glory Hole Creek | S | A |
| Z7 | Lodgepole Creek above Reservation | C | A |
| Z8 | Kalal Water Supply | C + CN | A |
| Z9 | Right-hand Ruby Water Supply | C + CN | A |
| Z11 - Z(4) | Shallow Monitoring Wells at Zortman Precipitation Plant | (C + CN)[3]<br>P | S<br>M |
| Z21 | Pad and Pond Seepage Collection System | P<br>C + CN | M<br>S |
| Z22 | Deep Monitoring Well =1<br>=n | (C + CN), P<br>(C + CN), P | S, M<br>S, M |
| Z | Intermediate Monitoring Well A<br>B<br>n | (C + CN), P<br>(C + CN), P<br>(C + CN), P | S, M<br>S, M<br>S, M |

(1) P = Partial, etc

(2) A = Annually, etc.

(3) Checked weekly for water level. If water is present sample for C + CN.

(4) Will be added when drilling program completed.

Appendix B

SEEDING RECOMMENDATION

| Grasses | #/acre PLS |
|---|---|
| Kentucky bluegrass | 1 |
| Mountain brome | 3 |
| Thickspike wheatgrass | 4 |
| Big bluegrass | 2 |
| Smooth brome | 2 |
| Hard fescue | 2 |
| Timothy | 2 |
| Pubescent wheatgrass | 2 |
| Bluebunch wheatgrass (or Thitmar if Bluebunch wheatgrass not available) | 2 |
| **Forbs** | |
| Red Clover | ½ |
| Yellow sweet clover | ¼ |
| **Shrubs and Trees** | |
| Chokecherry | T |
| Serviceberry | T |
| Ponderosa pine | seedlings desirable |
| Douglas fir | seedlings desirable |
| Lodge Pole pine | seedlings desirable |

Appendix C. Birds of the Little Rockies

| | | 1962[a] | 1978[b] | 1978[c] |
|---|---|---|---|---|
| **Falconiformes** | | | | |
| Cooper's hawk | Accipiter cooperii | | | x |
| Red-tailed hawk | Buteo jamaicensis | | | x |
| Swainson's hawk | Buteo swainsoni | | x | |
| Golden eagle | Aquila chrysaetos | x | | x |
| Prairie falcon | Falco mexicanus | x | | |
| Peregrine falcon | Falco peregrinus | x | | |
| Pigeon hawk (Merlin) | Falco columbarius | x | | |
| American kestrel | Falco sparverius | x | | x |
| **Galliformes** | | | | |
| Blue grouse | Dendragapus obscurus | | x | x |
| Sharp-tailed grouse | Pediocetes phasianellus | | | x |
| Ring-necked pheasant | Phasianus colchicus | x | | x |
| Turkey | Meleagris gallopavo | | | |
| **Columbiformes** | | | | |
| Mourning dove | Zenaida macroura | x | | x |
| Rock dove | Columba livia | | | x |
| **Strigiformes** | | | | |
| Great horned owl | Bubo virginianus | x | | x |
| **Caprimulgiformes** | | | | |
| Poor-will | Phalaenoptilis nuttallii | | | x |
| Common nighthawk | Chordeiles minor | x | | x |
| **Apodiformes** | | | | |
| White-throated swift | Aeronautes saxatilis | x | | |
| **Piciformes** | | | | |
| Common flicker | Colaptes auritus | x | | x |
| Yellow-bellied sapsucker | Sphyrapicus varius | | | x |
| Hairy woodpecker | Dendrocopos villosus | x | | x |
| **Passeriformes** | | | | |
| Eastern kingbird | Tyrannus tyrannus | x | | |
| Dusky flycatcher | Empidonax oberholseri | x | x | |
| Western flycatcher | Empidonax difficilis | x | x | x |

Appendix C

| Passeriformes (cont.) | | 1962 [a] | 1973 [b] | 1978 [c] |
|---|---|---|---|---|
| Western woodpewee | Contopus sordidulus | x | | x |
| Horned lark | Eremophila alpestris | x | | x |
| Violet-green swallow | Tachycineta thalassina | x | | x |
| Barn swallow | Hirundo rustica | | | x |
| Black-billed magpie | Pica pica | x | | x |
| Common crow | Corvus brachyrhynchos | x | | |
| Clark's nutcracker | Nucifraga columbiana | x | x | x |
| Black-capped chickadee | Purus atricapillis | x | | x |
| Mountain chickadee | Parus gambeli | x | | x |
| Red-breasted nuthatch | Sitta canadensis | x | | x |
| Brown creeper | Certhia familiaris | | | x |
| Dipper | Cinclus mexicanus | | | x |
| House wren | Troglodytes aedon | x | | x |
| Rock wren | Salpinctes obsoletus | x | | |
| Gray catbird | Dumetella carolinensis | x | | x |
| Brown thrasher | Toxostoma rufum | x | | |
| American robin | Turdus migratorius | x | | x |
| Hermit thrush | Catharus guttata | x | x | x |
| Swainson's thrush | Catharus ustulata | x | x | x |
| Veery | Catharus fuscescens | x | | |
| Mountain bluebird | Sialia currucoides | x | | x |
| Townsend's solitaire | Myadestes townsendi | x | x | x |
| Ruby-crowned kinglet | Regulus calendula | | x | x |
| Bohemian waxwing | Bombycilla garrulus | | | x |
| Cedar waxwing | Bombycilla cedrorum | x | | |
| Loggerhead shrike | Lanius ludovicianus | X | | X |
| Red-eyed vireo | Vireo olivaceus | x | | |
| Warbling vireo | Vireo gilvus | x | | x |
| Orange-crowned warbler | Vermivora celata | x | x | |
| Yellow warbler | Dendroica petechia | x | | |
| Yellow-rumped warbler | Dendroica coronata | x | x | x |
| Ovenbird | Seiurus aurocapillus | x | | |
| MacGillivray's warbler | Oporornis tolmiei | x | x | x |
| Yellowthroat | Geothlypis trichas | x | | |
| Yellow-breasted chat | Icteria virens | x | | |
| American redstart | Steophaga ruticilla | x | | |
| House sparrow | Passer domesticus | x | | |
| Western meadowlark | Sturnella neglecta | x | | x |
| Yellow-headed blackbird | Xanthocephalus xantho-cephalus | x | | |
| Red-winged blackbird | Agelaius phoeniceus | x | | |
| Brewer's blackbird | Euphaga cyanocephalus | x | | |
| Common grackle | Quiscalus quiscula | x | | |
| Brown-headed cowbird | Molothrus ater | x | | x |
| Western tanager | Piranga ludoviciana | x | x | x |
| Lazuli bunting | Passerina amoena | x | | |
| Evening grosbeak | Hesperiphone vespertina | x | x | |
| Gray-crowned rosy finch | Leucosticte tephrocotis | | | x |
| Pine siskin | Spinus pinus | x | x | x |
| American goldfinch | Spinus tristis | x | | x |
| Red crossbill | Loxia curvirostra | x | x | x |
| Rufous-sided towhee | Pipilo erythrophthalmus | x | | x |
| Vesper sparrow | Pooecetes gramineus | x | | x |
| Lark sparrow | Chondestes grammacus | x | | x |
| Dark-eyed junco | Junco hyemalis | x | x | x |

| Passeriformes (cont.) | | 1962 [a] | 1978 [b] | 1978 [c] |
|---|---|---|---|---|
| Chipping sparrow | Spizella passerina | x | | x |
| White-crowned sparrow | Zonotrichia leucophrys | x | x | x |
| Song sparrow | Melospiza melodia | x | | x |
| McCown's Longspur | Calcarius mccownii | x | | |

[a] DeLap, 1962 - note DeLap's study encompassed lowland and prairie influences not directly associated with the Little Rockies proper, thus the 1962 list includes a number of species not pertinent to this (1978) study.

[b] Thompson, 1978 - this list is limited to probable breeding species of the Little Rockies "island" mountain range (from DeLap, 1961).

[c] Definitive observations for this study, within the aerial survey boundary.

Appendix D. Mammals recorded in the Little Rockies, 1978[a].

| | |
|---|---|
| **Insectivora** | |
| Common, or masked shrew | *Sorex cinereus* |
| **Lagomorpha** | |
| White-tailed jackrabbit | *Lepus townsendii* |
| Mountain cottontail | *Sylvilagus nuttallii* |
| **Rodentai** | |
| Porcupine | *Erethizon dorsatum* |
| Beaver | *Castor candensis* |
| Northern pocket gopher | *Thomomys talpoides* |
| Yellow-bellied marmot | *Marmota flaviventris* |
| Least chipmunk | *Eutamias minimus* |
| House mouse | *Mus musculus* |
| Bushy-tailed wood rat | *Neotoma cinerea* |
| Deer mouse | *Peromyscus maniculatus* |
| Long-tailed vole | *Microtus longicaudus* |
| Meadow vole | *Microtus pennsylvanicus* |
| **Carnivora** | |
| Coyote | *Canis latrans* |
| Badger | *Taxidea taxis* |
| Striped skunk | *Mephitis mephitis* |
| **Artiodactyla** | |
| White-tailed deer | *Odocoileus virginianus* |
| Mule deer | *Odocoileus hemionus* |
| Bighorn sheep | *Ovis canadensis* |

[a] names from Hoffman and Pattie (1968).

Appendix E

Removal of Vegetation by Community Type for the Landusky and Zortman Operations

COMMUNITY TYPE

| Disturbance | Grassland | | LPP/ Scree | | LPP/ Juniper | | LPP/ Mixed Shrub | | LPP/ Twinflower | |
|---|---|---|---|---|---|---|---|---|---|---|
| | L | Z | L | Z | L | Z | L | Z | L | Z |
| Pit area | - | 1.25 | - | - | - | - | 6.28 | 4.84 | 1.61 | 8.66 |
| Waste area | - | 1.28 | - | - | - | - | - | 1.32 | - | - |
| Roads | 0.08 | - | - | 0.55 | - | 0.41 | - | 3.41 | - | - |
| Plant sites and ponds | - | - | - | 1.54 | - | 0.22 | - | 2.64 | - | - |
| Leach pad (heap) | 1.32 | - | - | - | - | 6.27 | - | 3.67 | 0.81 | - |
| Soil stockpile | 1.87 | - | - | - | - | 0.04 | - | 2.31 | - | - |
| Total | 3.27 | 2.53 | 0 | 2.09 | 0 | 6.94 | 6.28 | 18.19 | 2.42 | 8.66 |

Z = Zortman Area

L = Landusky Area

LPP = lodgepole pine

PP = Ponderosa pine

DF = Douglas fir

Note: Acreage of areas previously disturbed are not included

COMMUNITY TYPE

| Disturbance | PP/ grass | | PP/ Kinnikinnick | | PP/ Snowberry | | Aspen | | PP/DF Plantation | |
|---|---|---|---|---|---|---|---|---|---|---|
| | L | Z | L | Z | L | Z | L | Z | L | Z |
| Pit area | 1.76 | - | - | - | - | - | - | - | - | - |
| Waste area | 0.84 | - | - | - | - | - | - | 0.04 | - | - |
| Roads | - | - | 0.83 | 0.83 | - | - | - | 0.10 | 0.55 | - |
| Plant sites and ponds | - | - | 5.76 | - | - | - | - | - | - | - |
| Leach pad (heap) | - | - | 21.25 | 0.51 | - | - | - | - | 0.26 | - |
| Soil stockpile | 0.22 | - | - | - | - | - | - | - | - | - |
| Total | 2.82 | 0 | 27.84 | 1.34 | 0 | 0 | 0 | 0.14 | 0.81 | 0 |

Z = Zortman Area

L = Landusky Area

LPP = lodgepole pine

PP = Ponderosa pine

DF = Douglas fir

Note: Acreage of areas previously disturbed are not included

Explanation of geologic symbols within areas of interest

Tt

Trachyte porphyry dike — Tertiary

Tsp

Syenite porphyry

Ml

Lodgepole limestone

Limestone, richly fossiliferous, thin bedded, with some massive ledges, many small lenses of chert, and thin partings of shale; mostly dark to light gray, but two zones in upper half are predominantely red; at base is thin black conodont-bearing shale of Little Chief Canyon member. — Mississippian

Du

Devonian and Mississippian rocks, undifferentiated

Includes three formations. Uppermost (poorly exposed) is Three Forks shale (?) (Devonian and Mississippian) consisting of calcareous clay and siltstone, light gray to light green, resting on Jefferson limestone (Devonian). The Jefferson limestone consists of an upper member; limestone and dolomite, light gray to buff, partly sandly, massively bedded but slabby where greatly weathered; a middle member: shale, siltstone, and thinly laminated dolomite and limestone; and a lower member: chiefly limestone, finely crystalline, dark gray and brownish gray, weathering light gray to whitish. Lowermost is Maywood formation (Devonian), consisting of shale, siltstone, limestone, and dolomite, upper two-fifths largely bright red; lower three-fifths mainly light gray, light green, yellow, and brown; lower 5 ft is pinkish dolomite, silty, platy. — Devonian and Mississippian

Ob

Bighorn dolomite

Lower half; dolomitic limestone, massive, dapple gray with bluish cast in some exposires; weathered surfaces commonly pitted. Upper half; dolomite, thinly bedded, hard, gray to white. — Ordovician

O€u

Flathead sandstone and Emerson formation, undifferentiated

The Emerson formation (Cambrian and Early Ordovician (?) is chiefly gray to greenish-gray shale with thin intercalated beds, increasing in number upward, of shale, limestone, dolomite, and edgewise intraformational conglomerate. The lower formation, the Flathead sandstone (Cambrian) is mainly sandstone, light gray, green and tan, with some interbedded fine-grained conglomerate. — Cambrian and Ordovician

P€u

Pre-Belt metamorphic rocks, undifferentiated

Metasedimentary rocks, chiefly biotite schist and gneiss; metavolcanic rocks, chiefly hornblende gneiss and amphibolite; and younger pre-Belt (?) ferromagnesian rocks forming a few dikes and sills. — Precambrian